



**The University of Texas
Graduate School of Biomedical Sciences
at Houston**

**Addendum
to the
2014-16 Catalog**



ADDENDUM TO
General Information Section
Graduate School of Biomedical Sciences
2014-2016

Reason for change: Program name change from “Molecular Carcinogenesis” to “Epigenetics and Molecular Carcinogenesis”

CURRENT: (p.68)

School/Program	Degree	Cert.	Bach.	Mast.	Doc.
Graduate School of Biomedical Sciences	M.S. in Biomedical Sciences (with concentrations in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Biomedical Sciences; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Experimental Therapeutics; Genes and Development; Genetic Counseling; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Molecular Carcinogenesis ; Neuroscience; Virology and Gene Therapy).			X	

(p.69)

School/Program	Degree	Cert.	Bach.	Mast.	Doc.
Graduate School of Biomedical Sciences	Ph.D. in Biomedical Sciences (with concentrations in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Biomedical Sciences; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Experimental Therapeutics; Genes and Development; Genetic Counseling; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Molecular Carcinogenesis ; Neuroscience; Virology and Gene Therapy).				X

(p.114)

The curricular recommendations developed by the Programs provide sufficient flexibility to permit students to develop an individualized program of study within the Program's framework. At the PhD level, current organized Programs of study include:

- Biochemistry and Molecular Biology
- Biostatistics
- Bioinformatics and Systems Biology
- Cancer Biology
- Cell and Regulatory Biology
- Clinical and Translational Sciences
- Experimental Therapeutics
- Genes and Development
- Human and Molecular Genetics
- Immunology
- Medical Physics
- Microbiology and Molecular Genetics
- Molecular Carcinogenesis**
- Neuroscience
- Virology and Gene Therapy

CHANGE TO:

School/Program	Degree	Cert.	Bach.	Mast.	Doc.
Graduate School of Biomedical Sciences	M.S. in Biomedical Sciences (with concentrations in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Biomedical Sciences; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Epigenetics and Molecular Carcinogenesis ; Experimental Therapeutics; Genes and Development; Genetic Counseling; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Neuroscience; Virology and Gene Therapy).			X	

School/Program	Degree	Cert.	Bach.	Mast.	Doc.
Graduate School of Biomedical Sciences	Ph.D. in Biomedical Sciences (with concentrations in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Biomedical Sciences; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Epigenetics and Molecular Carcinogenesis ; Experimental Therapeutics; Genes and Development; Genetic Counseling; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Neuroscience; Virology and Gene Therapy).				X

The curricular recommendations developed by the Programs provide sufficient flexibility to permit students to develop an individualized program of study within the Program's framework. At the PhD level, current organized Programs of study include:

Biochemistry and Molecular Biology
 Biostatistics
 Bioinformatics and Systems Biology
 Cancer Biology
 Cell and Regulatory Biology
 Clinical and Translational Sciences
Epigenetics and Molecular Carcinogenesis
 Experimental Therapeutics
 Genes and Development
 Human and Molecular Genetics
 Immunology
 Medical Physics
 Microbiology and Molecular Genetics
 Neuroscience
 Virology and Gene Therapy

ADDENDUM TO
Graduate School of Biomedical Sciences
2014-2016

Reason for change: Addition of accreditation information to Specialized M.S. in Genetic Counseling program description

CURRENT: (p.122)

The specialized Master of Science degree in Genetic Counseling is designed for individuals who seek a terminal MS degree with requisite education in human genetics and genetic counseling skills. The program's objective is to provide clinical and research training in genetic counseling, with graduating students demonstrating proficiency in genetic counseling competencies and having accrued a substantial and diverse clinical case experience in order to sit for the American Board of Genetic Counseling credentialing exam. The program's challenging curriculum provides comprehensive training in medical genetics and genomics cancer genetics, prenatal genetics, psychosocial counseling, and genetic counseling research. Students receive an in-depth exposure to a variety of genetics clinics. In addition to the general MS requirements, the Genetic Counseling Program requirements include the successful completion of specialized courses, clinical rotations and a masters of science thesis.

CHANGE TO:

The specialized Master of Science degree in Genetic Counseling is designed for individuals who seek a terminal MS degree with requisite education in human genetics and genetic counseling skills. The program's objective is to provide clinical and research training in genetic counseling, with graduating students demonstrating proficiency in genetic counseling competencies and having accrued a substantial and diverse clinical case experience in order to sit for the American Board of Genetic Counseling credentialing exam. The program's challenging curriculum provides comprehensive training in medical genetics and genomics cancer genetics, prenatal genetics, psychosocial counseling, and genetic counseling research. Students receive an in-depth exposure to a variety of genetics clinics. In addition to the general MS requirements, the Genetic Counseling Program requirements include the successful completion of specialized courses, clinical rotations and a masters of science thesis. **The program is fully accredited by the Accreditation Council for Genetic Counseling, located at 18000 W. 105th Street, Olathe, KS 66061. Telephone: 913.895.4629; Fax: 913.895.4652; Website: www.gceducation.org.**

ADDENDUM TO
Graduate School of Biomedical Sciences
2014-2016

Reason for change: Addition of accreditation information to Specialized M.S. in Medical Physics program description

CURRENT: (p.124)

The Specialized Master of Science in Medical Physics Program prepares students for a clinically-oriented career in medical physics 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's requirements entail coursework, thesis research and clinical rotations.

CHANGE TO:

The Specialized Master of Science in Medical Physics Program prepares students for a clinically-oriented career in medical physics 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's requirements entail coursework, thesis research and clinical rotations. The Program is accredited by the Commission on Accreditation of Medical Physics Education Programs, Inc., located at One Physics Ellipse, College Park, MD 20740. Telephone: 301.209.3346; Fax: 301.209.0862; Website: www.campep.org.

The University of Texas Graduate School of Biomedical Sciences at Houston

The University of Texas Health Science Center at Houston

and

The University of Texas MD Anderson Cancer Center

2014 – 2016 Catalog General Information Section



THE UNIVERSITY OF TEXAS
**MD Anderson
Cancer Center**

Making Cancer History®

The University of Texas Health Science Center at Houston (UTHealth) is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) to award certificate, baccalaureate, masters, doctoral, and professional degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of The University of Texas Health Science Center at Houston.

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 doctoral levels. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4501 for questions about the accreditation of The University of Texas MD Anderson Cancer Center.

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Message from the UT Health Science Center President



Giuseppe N. Colasurdo, M.D.

Welcome to The University of Texas Health Science Center at Houston (UTHealth) and to an exciting new chapter in your academic career. Your UTHealth education will be both challenging and enriching, and will prepare you to make a significant contribution in your chosen professional field.

UTHealth is the most comprehensive academic health center in The University of Texas System and educates more than 4,600 health professionals every year. Our School of Dentistry is more than 100 years old and rich in tradition; our Graduate School of Biomedical Sciences offers an innovative curriculum of postgraduate training in partnership with The University of Texas MD Anderson Cancer Center; our Medical School is the sixth largest in the nation and is home to the country's fastest growing academic clinical practice; our School of Biomedical Informatics offers a first-of-its-kind curriculum critical to improving health delivery, quality and safety; our School of Public Health has a statewide presence with five regional campuses; and our School of Nursing is ranked among the top five percent in the nation.

Completing your training at UTHealth will also provide you access to a broad patient population as well as opportunities to collaborate with students and faculty from all six of our schools, our affiliated partners and our neighboring institutions.

As you join the UTHealth family, know that you have tremendous resources at your service. The faculty and staff are here to provide you with more than education – we are also here to support and guide you on your professional journey. In return, I ask that you give us your very best – for your benefit and for the benefit of your classmates. We need bright young minds like yours to provide innovative solutions to the most pressing health problems of our time. I know that you will make us proud.

Thanks to each of you for trusting us with your education and, again, welcome to UTHealth.

Sincerely,

Giuseppe N. Colasurdo, M.D.

President

The University of Texas Health Science Center at Houston

Message from the UT MD Anderson Cancer Center President



Ronald A. DePinho, M.D.

Welcome to The University of Texas MD Anderson Cancer Center (MD Anderson). We are proud to be partners with UTHealth to offer programs at The University of Texas Graduate School of Biomedical Sciences. Through this unique collaboration, opportunities abound for graduate students to explore fascinating areas of research, to learn from exceptional faculty members and to become strong contributors to ongoing — and future — biomedical science advances.

At MD Anderson, we are uniquely positioned to move science forward to improve the human condition, and we will need the best prepared and most dedicated people working together to achieve the great gains we expect. Because research is at the core of our institutional mission and the future of cancer science, developing the finest possible educational programs and recruiting top students — who are training to become the next generation of research scientists — are among my highest priorities as president. Our Graduate School of Biomedical Sciences is key to our success.

As a graduate student here, you can be an important part of our Making Cancer History[®] mission at a critical time, when the field of cancer medicine is changing rapidly. We are poised to make a decisive assault on this disease as there is a powerful confluence of knowledge, computational firepower and the ability to manipulate genes. We welcome your contribution in striving to achieve the ultimate goal of conquering cancer.

Offering doctoral and master's degrees in diverse biomedical concentrations, the University of Texas Graduate School of Biomedical Sciences enables you to develop your course work, research, and training and to study with scientists in the field that best meets your interests and goals. MD Anderson faculty collaborate with colleagues from UTHealth across multidisciplinary programs, providing you with a great environment in which to learn as well as the resources and mentoring you will need to advance.

Please take advantage of all you have at your fingertips. We look forward to hearing about the discoveries you make as you progress toward your degree and the launch of an independent, impactful career.

Ronald A. DePinho, M.D.

President

The University of Texas MD Anderson Cancer Center

On behalf of our entire university community I welcome you to UTHealth



George M. Stancel, Ph.D.

As a current or potential student or faculty member, interested parent, or member of the public it is important to know that our university provides a rich and stimulating environment that promotes learning, nurtures creativity, and fosters discovery. The combination of our six schools, multiple research institutes and centers, and hospital partners and clinics provides a wealth of opportunities for personal and professional growth, an outstanding education in a number of biomedical areas, obtaining professional competencies, and/or participating in research that leads eventually to improved health.

As with any university, teaching, learning, and the generation of new knowledge underlie everything we do. We demand true excellence of ourselves in all aspects of these missions and this self-imposed standard is the basis for important beliefs and actions that permeate our university community. We are rigorous in our recruitment of faculty and students who share our goals and commitment to excellence. We invest in leadership, both current and future, and provide an environment that helps our students, faculty and alumni become leaders at all levels.

- We highly value *diversity* and the contributions of every individual in our university community, including students, faculty and staff. We respect the individuals in each of these groups as well as our patients.
- We believe that *scholarship* is the foundation of all our activities, - in learning, in discovering new knowledge, and in teaching, integrating and applying that knowledge.
- We believe that service is an obligatory extension of our scholarship, and consequently, members of our university community translate and apply their knowledge and skills to care for patients, to treat and prevent disease, promote health, and to improve public policies related to education, research, and health care. These services are provided at the local, state, national and international levels.
- Our location and research activities benefit all of our educational programs. Our presence in the Texas Medical Center, in five regional campuses across Texas, in community hospitals, in clinics, and in local schools supports scholarly activity and helps apply new knowledge for the public good. Our physical plant includes more than 4 million gross square feet of space for education, basic science, translational, and clinical research, inpatient and ambulatory health care, and student housing, services, and recreation.
- The quality of our faculty and the number and breadth of our educational, research and patient care programs provide opportunities second to none for students to achieve their full potential. Our 19 academic degree and certificate programs employ cutting-edge technology and innovative educational approaches to student learning.
- We value both the individual and the team. Students learn to work with one another as well as faculty - learning from the knowledge, skills and experiences of both. We value one another, recognizing and celebrating the talents, creativity and character of each member of the team.

As a proud, longtime UTHealth employee I have seen first-hand that our university provides an outstanding environment for all individuals to grow through learning, discovery, and service. I am confident that those who join us will have positive experiences that will enrich their lives, contribute to the mission and reputation of our university, and benefit our community and the broader society. Welcome to UTHealth!

George M. Stancel, Ph.D.

Executive Vice President, Academic Affairs and Research
The University of Texas Health Science Center at Houston

Welcome...



Ethan Dmitrovsky, M.D.

The University of Texas MD Anderson Cancer Center (MD Anderson) has enjoyed a long association in education and research with our sister institution in the Texas Medical Center, The University of Texas Health Science Center at Houston (UTHealth). We are particularly proud of our joint operation of The University of Texas Graduate School of Biomedical Sciences at Houston. M D Anderson's entire basic science faculty and many of our clinical faculty teach, participate in committees and mentor students in the School. Education is one of MD Anderson's main missions and our faculty, staff, and administration are committed to your career development and professional success.

MD Anderson is a leader among the nation's comprehensive cancer centers. We excel in research as attested by our leading the nation in the number of individually awarded grants and total funding received from the National Cancer Institute. Our excellence in collaborative and multidisciplinary research is also shown by our receipt of more Specialized Programs of Research Excellence (SPORES) grants than any other institution. For graduate students, this translates into exciting opportunities to participate in and add to important and innovative biomedical research.

MD Anderson also has over 100 training grants and individually awarded fellowships for research training. These are awarded because other scientists and clinicians across the United States recognize the quality of the research training and education environment at MD Anderson.

We recognize that learning how to conduct innovative research is only one facet of a successful career. We have also created supportive professional development programs to aid in your academic progress. Each year, we provide more than 100 seminars, workshops and other programs designed to help you learn about manuscript and grant writing, presentation skills, laboratory and personnel management, organizational and time management skills, work and life balance, managing stress, conflict management, negotiation skills and much more. We are committed to providing the finest possible resources to ensure your success and we look forward to your time in our graduate school and at MD Anderson and UTHealth.

Ethan Dmitrovsky, M.D.

Provost and Executive Vice President

The University of Texas MD Anderson Cancer Center

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MISSION AND VISION STATEMENTS

Teaching, Searching, Serving

Mission Statement

As a comprehensive health science university, the mission of The University of Texas Health Science Center at Houston 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.

We pursue 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.

To fulfill our mission, UTHealth:

1. Educates health professionals and scientists in a diverse interdisciplinary academic community.
2. Creates and evaluates new knowledge – through basic science and applied research – as it relates to disease prevention, treatment, and cure
3. Provides leadership and advances scholarship in biomedical sciences, health professions, health promotion, public health policy and health care delivery.
4. Models appropriate and compassionate clinical care.
5. Addresses the health needs of the community at large through public health expertise, information, outreach and service.
6. Develops the expanding field of health information science.

Vision Statement

“Excellence above all” in the quest to be an acknowledged leader in the collaboration to treat, cure, and prevent the most common diseases of our time through education, research and clinical practice.

The University of Texas Health Science Center at Houston aspires to be a leader in the collaborative effort to treat, prevent, and cure the most common diseases of our time by:

1. Utilizing the distinctive capabilities of its schools, clinics, institutes, and centers;
2. Collaborating with colleagues in The University of Texas System, the Texas Medical Center, and throughout the world;
3. Being an academic health science center that is nationally and internationally recognized in teaching, research, and service;
4. Serving as a home for the visionaries and scholars who will lead the way in defining and creating the future of the health sciences; and
5. Providing a diverse work environment that is ethically-based, service-oriented, and community-sensitive.

MISSION, VISION & CORE VALUES OF MD ANDERSON

Eliminating cancer in Texas, the nation and the world

Mission

The mission of The University of Texas MD Anderson Cancer Center (MD Anderson) 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.

Vision

We shall be the premier cancer center in the world, based on the excellence of our people, our research-driven patient care and our science. We are Making Cancer History™.

Core Values

Caring

By our words and actions we create a caring environment for everyone.

- We are sensitive to the concerns of our patients and our co-workers.
- We are respectful and courteous to each other at all times.
- We promote and reward teamwork and inclusiveness.

Integrity

We work together to merit the trust of our colleagues and those we serve.

- We hold ourselves, and each other, accountable for practicing our values.
- We communicate frequently, honestly and openly.
- By our actions, we create an environment of trust.

Discovery

We embrace creativity and seek new knowledge.

- We help each other to identify and solve problems.
- We seek personal growth and enable others to do so.
- We encourage learning, creativity and new ideas.

GENERAL INFORMATION

History of The University of Texas System

The idea of a University of Texas is as old as the State. The Texas Declaration of Independence lists as one of its main indictments against the government of Mexico the fact that “it has failed to establish any public system of education...” Several early attempts were made to establish a state university, but they were not successful because of the Civil War and subsequent Era of Reconstruction. Establishment of a state university for Texas was provided first by act of the State Legislature in 1881. It provided for the location of the institution by popular vote and for appointment of a Board of Regents to be entrusted with its organization and governance. By results of an election in September 1881, the site of the main university was designated as Austin and Galveston was chosen as the location for the Medical Branch. An undergraduate college and law school was established and The University of Texas formally opened on September 15, 1883.

Since then numerous campuses, schools, colleges, divisions and branches have been added to The University of Texas System at several locations throughout the state. The System now includes academic campuses in Arlington, Austin, Brownsville, Dallas, El Paso, Midland/Odessa (UT Permian Basin), San Antonio, Tyler and Edinburg. The health science centers are located at Dallas, Galveston, Houston, and San Antonio. A health center (hospital) is located in Tyler. The University of Texas MD Anderson Cancer Center is located in Houston.

Other components of the System include the Institute of Texas Cultures (at San Antonio), the Institute of Humanities in Medicine (UT Medical Branch, Galveston), the Environmental Science Park near Smithville (UT MD Anderson Cancer Center), the Marine Science Institute in Port Aransas (UT Austin), the McDonald Observatory at Fort Davis (UT Austin), and the Shriners Burn Institute (in conjunction with UT Medical Branch, Galveston).

The University of Texas Health Science Center at Houston

The University of Texas Health Science Center at Houston (UTHealth) was established in late 1972 to administer and provide for the operation of the several biomedical and health-related units located in the city through the integration and coordination of functions and activities. The Health Science Center presently includes, by order of establishment:

1905	School of Dentistry (originally as the Texas Dental College)
1963	Graduate School of Biomedical Sciences
1967	School of Public Health
1970	Medical School
1972	School of Nursing
1973	School of Biomedical Informatics (originally as the School of Allied Health Sciences)
1990	Harris County Psychiatric Center
1995	Brown Foundation Institute of Molecular Medicine for the Prevent of Human Diseases

As a component of The University of Texas System, UTHealth is subject to the The University of Texas System Board of Regents -- Rules and Regulations for the governance of The University of Texas System.

The official name of the institution is The University of Texas Health Science Center at Houston. It is informally termed UTHealth or the Health Science Center.

Today, UTHealth employs more than 1,538 faculty, 3,926 staff and has 4,600 students enrolled in various health and biomedical disciplines at its component schools and regional campuses.

UTHealth Addresses*

School of Dentistry

7500 Cambridge St.
Houston, TX 77054

Medical School

Medical School Building
6431 Fannin
Houston, TX 77030-1503

**Graduate School of Biomedical
Sciences**

6767 Bertner Ave., Rm 3.8344
Houston, TX 77030

School of Biomedical Informatics

(University Center Tower)
7000 Fannin, Suite 600
Houston, TX 77030

School of Nursing

6901 Bertner
Houston, TX 77030

School of Public Health

(Reuel A. Stallones Building)
1200 Herman Pressler
Houston, TX 77030-3900

Child Development Center

7900 Cambridge
Houston, TX 77054-5500

Jesse Jones HAM-TMC Library

1133 John Freeman Blvd.
Houston, TX 77030

Harris County Psychiatric Center

2800 S. MacGregor Way
Houston, TX 77021

**Brown Foundation Institute of
Molecular Medicine for the Prevention
of Human Diseases**

1825 Hermann Pressler St.
Houston, TX 77030

Recreation Center

7779 Knight Road
Houston, TX 77054

Registrar Office

(University Center Tower)
7000 Fannin, Suite 2250
Houston, TX 77030

Student Financial Services

(University Center Tower)
7000 Fannin, Suite 2220
Houston, TX 77030

**Student Health and
Counseling Services**

6410 Fannin, Suite 130
Houston, TX 77030

UT Counseling/Worklife Services

UTHealth Administrative Offices

(University Center Tower)
7000 Fannin
Houston, TX 77030

UT Police Department

7777 Knight Road
Houston, TX 77054

UTHealth Professional Building

6410 Fannin
Houston, TX 77030

*Unless otherwise clearly posted or expressed by an authorized official of The University of Texas Health Science Center at Houston (UTHealth), the various UTHealth facilities and locations are open only to persons with legitimate business purposes requiring presence at such facilities and locations UTHealth allows only agents of UTHealth, employees acting within the scope of their employment with UTHealth, the Student InterCouncil, and other registered student, faculty, and staff organizations to solicit on the grounds, sidewalks, or streets of the UTHealth campus or in any building, structure, or facility owned, controlled, or operated by UTHealth, and only with prior written approval.

Institutional Governance

Institutional governance at The University of Texas Health Science Center at Houston is supported by a system of councils and standing committees. As a whole, these councils enhance communication both vertically and horizontally within the university; enable leaders and constituent representatives from each of the major mission areas to participate in exchange of information and decision making; and incorporate ideas and points of view from a variety of students, faculty and staff in the decision-making process. Deliberations and recommendations from councils provide assistance to executive leadership of the university as they make decisions about the university's future and well-being. The University Executive Council is responsible for advising the President on key issues related to institutional governance and operations.

Standing Committees

Animal Welfare Committee
Audit Committee
Biological Safety Committee
Chemical Safety Committee
Committee for the Protection of Human Subjects
Committee on the Status of Women
Faculty Development Leave Committee
Institutional Biosafety Committee
Intellectual Property Committee
Interfaculty Council
Radiation Safety Committee
Research Conflicts of Interest Committee
Safety Council
Student InterCouncil

Student Services Council
University Appointment, Promotion and Tenure Committee
University Classified Staff Council
University Leadership Council
Work/Life Council

Development Board

The University of Texas Health Science Center at Houston Development Board consists of approximately 180 community leaders who have committed to advance the mission and vision of the health science center by increasing public awareness and philanthropic support through advocacy, service and investment.

UTHEALTH CENTERS, PROGRAMS AND INSTITUTES

A variety of interdisciplinary centers, institutes and programs have been created to enrich the primary programs of the schools of UTHealth. In general, they focus on specific service and research efforts while the institutes provide opportunities for special multidisciplinary educational projects. These efforts reinforce UTHealth's commitment to providing a means through which the health professions may join with each other and with society to consider health-related issues.

Listed below are a few of UTHealth's centers. A more comprehensive listing can be found at www.uthouston.edu/index/institutes-centers.htm.

The Brown Foundation Institute of Molecular Medicine for the Prevention of Human Diseases

Advances in molecular and cell biology have enormous potential for innovative medical research and the future practice of medicine with more novel therapies. These approaches have been most successfully used to determine the causes of infectious disorders and genetic diseases. However, it is clear that molecular and cell biology will play a major role in clarifying the causes of many unsolved problems of modern medicine: heart disease, hypertension, vascular disorders, major mental illnesses, and inflammatory and immunologic diseases. The Brown Foundation Institute of Molecular Medicine for the Prevention of Human Diseases (IMM) houses nine research centers and several support laboratories, each exploring the genetic and molecular aspects of biological processes significant to explain the basis of human diseases.

The long-term goals of the IMM are to set the example for research excellence and collaborations locally, nationally, and internationally. Scientifically, the IMM is on the verge of a new frontier of expansion and collaborations. The IMM has two major objectives: discovery through medical advancements driven by breakthrough discoveries which give new insight into disease that lead to new solutions; and patient benefit from such solutions. New diagnostics and therapies are a derivative of discovery. The IMM has organized Texas talent in the Texas Therapeutics Institute to achieve this goal of patient benefit from discovery.

Website: <http://www.uthouston.edu/imm/>

Center for Laboratory Animal Medicine & Care (CLAMC)

The Center for Laboratory Animal Medicine and Care (CLAMC) is a program accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC-International), and meets all standards mandated by the Animal Welfare Act, Center for Disease Control, National Research Council Guide for the Care and Use of Laboratory Animals and the Public Health Service Policy on Humane Care and Use of Laboratory Animals. CLAMC is responsible for the management and operations of all animal care and use programs for UTHealth. CLAMC includes six physically separate animal facilities and numerous satellites on the Texas Medical Center campus. The program provides professional veterinary, surgical, and animal care services in support of principal investigators' animal use studies. The CLAMC is an integral part of UTHealth's research and teaching mission and provides the highest standards possible for ensuring the health and well-being of laboratory animals used in biomedical research. CLAMC staff includes five veterinarians, one veterinary resident, seven veterinary technicians, and approximately 30 animal care and support personnel.

Website: <http://www.uthouston.edu/animal-research/clamc.htm>

John P. McGovern, M.D., Center for Humanities and Ethics

Established in 2004, The John P. McGovern, M.D. Center for Humanities and Ethics promotes excellence in scholarship and teaching in the medical humanities and ethics. It provides an interdisciplinary forum where scholars, students, physicians, and other health care professionals examine questions of value and meaning in search of ethically sound and spiritually informed patient care. Appropriately, the Center bears the name of John P. McGovern, M.D. (1921-2007) who founded the American Osler Society and throughout his lifetime championed the importance of the compassionate art of medicine.

The McGovern Center is housed in the Medical School but serves all six schools at UTHealth. Drawing from bioethics, medical history, health law, spirituality, literature and the arts, the Center offers courses, lectures, research seminars, faculty workshops and consultation. It provides opportunities for collaborative research and professional development for students, residents and faculty. The Center collaborates closely with other academic institutions in Houston including Rice University, UT MD Anderson Cancer Center, and the University of Houston, as well as the Museum of Fine Arts and the Jung Center.

The Center established a Medical Humanities Certificate Program in 2006. This four-year program enriches medical students' education through additional study and involvement in the humanities, including participation in elective courses, seminars and ethics grand rounds, community outreach opportunities, writing workshops and directed research, leading to a Certificate in the Medical Humanities.

In 2009, the Center launched a Campus-Wide Ethics Program to enhance the ethics and professionalism curricula at each of the six schools of UTHealth. Beginning in 2011, all UTHealth students are required to take an introductory ethics and professionalism curriculum called "The Brewsters." The Brewsters is a choose-your-own adventure, on-line, three-part module where students immerse themselves as characters caught up in ethical dilemmas.

Website: <http://www.uth.tmc.edu/hhhs/>

Center for Clinical and Translational Sciences

The goal of the Center for Clinical and Translational Sciences (CCTS) is to facilitate clinical and translational research at The University of Texas Health Science Center at Houston, The University of Texas MD Anderson Cancer Center, and the Memorial Hermann Hospital System. The CCTS is one of the original 12 such centers funded by the National Institutes of Health's Clinical and Translational Science Awards (CTSAs) and is also a member of the Texas CTSA Consortium.

According to the NIH, "(t)ranslational research includes two areas of translation. One is the process of applying discoveries generated during research in the laboratory, and in preclinical studies, to the development of trials and studies in humans (T1 translation). The second area of translation (T2 translation) concerns research aimed at enhancing the adoption of best practices in the community."

The CCTS is comprised of a series of component programs and services designed to assist investigators and their teams in the development and performance of translational research projects. These components include: Biobank, Bioinformatics, Biostatistics and Design, Clinical Research Units, Community Engagement, Core Labs, Ethics and Advocacy, and Regulatory. In addition, the CCTS T32 program provides stipends for PhD students whose dissertation research is clearly translational or addresses a problem that has direct clinical implications and provides didactic courses, seminars, and other training activities. The program also supports the training and career development of postdoctoral fellows within UTHealth and MD Anderson Cancer Center. The goal of the program is to train truly interdisciplinary researchers by a meaningful blending of programs and disciplines that have been traditionally operated as stand-alone entities within schools of the UTHealth or units within MD Anderson.

Website: <http://ccts.uth.tmc.edu/>

The Center for Translational Injury Research (CeTIR)

The Center was established by funds from the Texas Emerging Technology Fund, UTHealth, and the Memorial Hermann Hospital Fund. The principle mission of the center is to lead in the research and development of next-generation medical technologies related to hemostasis, resuscitation, and computerized decision support of trauma patients. The need for translating trauma research from the bench to the bedside is as great a priority and CeTIR is in a unique position to link basic science research and clinical practice.

Website: <http://www.uth.tmc.edu/cetir/>

Consortium on Aging

The Consortium on Aging is a university-wide collaborative that allows UTHealth to leverage the existing strengths of its many schools and centers and focus on addressing the health care needs of older adults. The Consortium's mission includes comprehensive care for older adults and their caregivers; education of future health care providers, the current workforce and the community at large; and, research to expand our understanding of aging.

Website: <http://www.uthouston.edu/aging/>

The University of Texas Harris County Psychiatric Center

The University of Texas Harris County Psychiatric Center (UTHCPC) opened in 1986 and is the only acute care, public psychiatric facility in Harris County serving persons with debilitating chronic mental illness.

UTHCPC is dedicated to excellence and leadership in the treatment of persons with mental illness. It shares the additional unique missions of UTHealth of conducting research into the causes and cures of mental illness, providing education of professionals in the care of mental illness and acting as a community resource providing outreach to the community.

- UTHCPC and The University of Texas Medical School Department of Psychiatry offers a comprehensive program of in-patient (UTHCPC) and outpatient (Department of Psychiatry) diagnostic and treatment services for: Children and adolescents, ages 3 through 17 with depression, bipolar disease, schizophrenia, personality disorders, attention deficit disorders and hyperactivity disorder; and
- Adults ages 18 and up with bipolar disorders, depression, schizophrenia, dementia, psychosocial or personality disorders.

UTHCPC's treatment programs offer individualized treatment plans; individual and group counseling and therapy; family participation; discharge planning and community follow-up referrals. UTHCPC utilizes a multidisciplinary team approach, including, as needed, psychiatrists, nurses, residents, psychologists, social workers, clinical programming therapists, dietitians and clergy.

UTHCPC serves more than 7,000 in-patients annually. Additionally, more than 700 students receive practical experience in the fields of medicine, psychiatry, psychology, nursing, social work, pharmacy, and activity therapy.

UTHCPC, in cooperation with the Harris County Mental Health and Mental Retardation Authority, also operates an active forensic competency restoration unit, providing care for those incarcerated by the Harris County Sheriff's Office in the Harris County Jail as well as other jail facilities throughout the area.

Website: <http://hcpc.uth.tmc.edu/>

The University of Texas MD Anderson Cancer Center

Celebrating more than seven decades of Making Cancer History®, The University of Texas MD Anderson Cancer Center (MD Anderson) is located in Houston on the sprawling complex of the Texas Medical Center. It is one of the world's most respected centers devoted exclusively to cancer patient care, research, education and prevention.

MD Anderson was created by the Texas Legislature in 1941 as a component of The University of Texas System, and has over 1,900 faculty (M.D. and Ph.D.). MD Anderson is one of the nation's original three Comprehensive Cancer Centers designated by the National Cancer Act of 1971 and, today is one of 41 Comprehensive Cancer Centers.

For ten of the past 12 years, including 2013, MD Anderson has ranked No. 1 in cancer care in the "best hospitals" survey published by U.S. News & World Report.

Patient Care

Since 1944, about 900,000 patients have turned to MD Anderson for cancer care in the form of targeted therapies, surgery, chemotherapy, radiation and proton therapy, immunotherapy or combinations of these and other treatments. The multidisciplinary approach to treating cancer was pioneered at MD Anderson. This brings together teams of experts across disciplines to collaborate on the best treatment plan for patients. And because MD Anderson's experts focus solely on cancer, they're renowned for treating all types of cancer, including rare or uncommon diseases.

In Fiscal Year 2012, MD Anderson provided cancer care for about 115,000 patients. Of those, nearly one-third were new patients. About one-third of patients come to Houston from outside Texas, seeking the knowledge-based care that has made MD Anderson so widely respected. There were about 8,500 registrants on clinical trials exploring novel therapies and diagnostic tests in FY12, making it the largest such program in the nation.

MD Anderson holds accreditation from the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). In 2006 and 2010, the American Nurses Credentialing Center renewed the Magnet Nursing Services Recognition designation at MD Anderson, the highest international award for nursing excellence.

Research

At MD Anderson, important scientific knowledge gained in the laboratory is rapidly translated into clinical care. Overall, MD Anderson's research program is considered one of the most productive efforts in the world aimed solely at cancer.

In FY12, MD Anderson invested more than \$647 million in research, an increase of 33% in the past five years. The institution ranks first in the number of research grants awarded and total amount of grants given by the NCI and holds 12 NCI Specialized Programs of Research Excellence (SPORE) grants in the following cancers: bladder, brain, breast, head and neck, leukemia, lung, lymphoma, melanoma, ovarian, pancreatic, prostate and uterine.

A new **Moon Shots Program** has launched to dramatically accelerate the pace of converting scientific discoveries into clinical advances that reduce cancer deaths. The program brings together multidisciplinary groups of researchers and clinicians to mount comprehensive attacks on eight cancers initially. They'll work as part of six moon shot teams: acute myeloid leukemia and myelodysplastic syndrome, chronic lymphocytic leukemia, melanoma, lung cancer, prostate cancer, and triple-negative breast and high-grade serous ovarian cancers, which are linked at the molecular level.

Creation of the Institute for Applied Cancer Science has expanded MD Anderson's research endeavors. The institute's goal is to identify and validate new cancer targets, convert the scientific knowledge into new cancer drugs, and advance the novel agents into innovative clinical trials through a streamlined collaboration between academic medicine and the biotechnology industry.

The new Sheikh Khalifa Bin Zayed Al Nahyan **Institute for Personalized Cancer Therapy** is an international center of clinical excellence focusing on using the latest advances in genetic information to develop safer, more effective treatments for patients on a case-by-case basis.

The **McCombs Institute for the Early Detection and Treatment of Cancer** comprises seven translational research centers focused on genomics, proteomics, screening, diagnostic imaging and drug development. They include the Cancer Metastasis Research Center, Center for Cancer Immunology Research, Robert J. Kleberg Jr. and Helen C. Kleberg Center for Molecular Markers, Proton Therapy Center, Center for Advanced Biomedical Imaging Research, Center for Targeted Therapy and Center for RNA Interference and Non-Coding RNAs.

In the **Institute for Basic Science**, researchers are working to better understand the makeup of healthy human cells, how they function under normal conditions and what happens when cancer develops. This knowledge will feed directly into clinical research, prevention, diagnosis and treatment

Education

In FY12, nearly 7,500 trainees, including physicians, scientists, nurses, and allied health professionals took part in MD Anderson educational programs. More than 300 students attended the institution's School of Health Professions, which offers bachelor's degrees in eight health disciplines. The School is launching a master of science in diagnostic genetics program in 2013..

More than 1,100 clinical residents and fellows come to MD Anderson each year to receive specialized training in the investigation and treatment of cancer. More than 550 graduate students are working on advanced degrees at the Graduate School of Biomedical Sciences, which MD Anderson operates with The University of Texas Health Science Center at Houston. The institution's laboratories provide training for 1,700-plus research fellows..

Thousands more participate in continuing education and distance learning opportunities sponsored by MD Anderson, sharing knowledge around the globe. The institution also provides public education programs to teach healthy people and at-risk populations about cancer symptoms and risk factors, offering information that can help them make critical health care decisions.

Prevention

MD Anderson continues to set the standard in cancer prevention research and the translation of new knowledge into innovative, multidisciplinary care for patients, survivors and people at average or elevated risk for developing cancer.

The Division of Cancer Prevention and Population Sciences is dedicated to eradicating cancer through pioneering research in the roles that biologic, genetic, environmental, behavioral and social factors play in cancer development and investigations of behavioral, surgical, medical and social interventions to prevent or reduce cancer risk.

Through the **Duncan Family Institute for Cancer Prevention and Risk Assessment**, the division is investing in promising new research directions and integrating basic research and clinical studies to accelerate their translation from the clinic to the community.

The new Department of Health Services Research is focused on studying health care costs, quality and access, and seeking ways to improve health care delivery, safety, availability and affordability.

The **Cancer Prevention Center** provides cancer risk assessments, screening exams based on genetics, age and gender, and personalized risk-reduction strategies, including chemoprevention.

Human Resources

MD Anderson employs more than 19,000 people, including more than 1,600 faculty. A volunteer corp of about 1,248 contributed more than 192,152 hours of service in FY12, equal to 92 full-time employees. All are dedicated to MD Anderson's core values of caring, integrity and discovery. Together, they work toward fulfilling the MD Anderson mission of eliminating cancer as a major health threat.

MD Anderson has been recognized as a top employer for its wellness programs, for workers 50 and older by the American Association of Retired Persons and for its employment practices for employees with disabilities. It also earned the No. 5 spot in Glassdoor.com's 2013 rankings of the nation's Best Places to Work.

Facilities

The majority of the MD Anderson-owned facilities in Houston are located on the North Campus (formerly known as main campus) and the South Campus. The annual operating budget for the institution exceeds \$3 billion and over \$623 million was spent on research in 2011.

MD Anderson leadership is committed to providing an infrastructure that supports all aspects of our mission, including provision of necessary space and facilities appropriate for research and education in each program area. Testimony to that commitment is the opening of new facilities and the construction that is currently underway. In the past seven years, 10 new buildings have opened at MD Anderson – the Ambulatory Clinical Building, the Cancer Prevention Building renamed the Dan L. Duncan Building, the George and Cynthia Mitchell Basic Sciences Research Building, the South Campus Research Buildings 1, 2, 3, 4, the Proton Therapy Center, the T. Boone Pickens Academic Tower, and the Mid Campus Building 1. MD Anderson's Texas Medical Center campus presently exceeds 11 million gross square feet.

In addition to MD Anderson's main campus in the Texas Medical Center in Houston, four regional care centers in the greater Houston area (Bay Area, Katy, Sugar Land, The Woodlands) and two research campuses in Bastrop County, Texas, the institution has developed a network of national and international locations.

MD Anderson leadership is also committed to facilitating the application of laboratory findings to the areas of prevention, diagnosis, and treatment of cancer. Exchanges between basic scientists and clinical investigators are facilitated so the discoveries of the former may be applied to the observations of the latter. In planning facilities, MD Anderson has placed clinical and basic science investigators in close proximity. This approach further augments and fosters interdisciplinary collaborations.

Several support activities, such as the UT Police, are joint activities of MD Anderson and UTHealth.

MD Anderson Addresses

The University of Texas MD Anderson Cancer Center (Street Address)

1515 Holcombe Blvd.
Houston, Texas 77030

The University of Texas MD Anderson Cancer Center (Mailing Address)

P.O. Box 20334
Houston, Texas 77225-0334

The University of Texas Graduate School of Biomedical Sciences at Houston

Office of the Dean
6767 Bertner Ave.,
Rm 3.8344
Houston, Texas 77030

MD ANDERSON CENTERS AND PROGRAMS

Center for Advanced Biomedical Imaging Research

Better Detection of Cancer & Heart Disease: Current imaging processes can identify diseased organs, but often not until the disease is advanced and harder to treat. Likewise, because small changes that reflect early response to therapy cannot be easily distinguished, it can be difficult to determine whether a treatment is effective early on.

The center's researchers and physicians will overcome these problems by developing and applying new, more sensitive molecular imaging agents for positron-emission tomography (PET), contrast computed tomography (CT), and magnetic resonance imaging (MRI) techniques.

GE Healthcare is contributing sophisticated technology and instrumentation, including a cyclotron to produce radionuclides. Scientists will use probes to seek out cancer cells with specific molecular abnormalities and image them with PET scanning and other technologies.

Rapid Measurement of Treatment Effectiveness: Advances in imaging allow physicians to select appropriate treatments and determine within hours or days (instead of many months) the effectiveness of cancer therapy.

Website: <http://www.mdanderson.org/education-and-research/research-at-md-anderson/early-detection-and-treatment/centers/center-for-advanced-biomedical-imaging/index.html>

Center for Biological Pathways

The Center for Biological Pathways at MD Anderson focuses on laboratory research to understand how molecular pathways function and how their dysregulation causes cancer, and makes cancer cells spread.

Cancer is caused by the abnormal functioning of critical genes. The tools and methods of basic science research are the key to discovering and understanding how the fundamental processes that go wrong in cancer work. MD Anderson is well positioned to not only bring the key questions from the clinic to basic cancer research, but also to translate laboratory discoveries back into clinical trials. New information from basic science—such as studies of the underlying cellular and molecular structures and processes of life, DNA, genes and alterations, stem cells, cell metabolism and signaling pathways—bring together the pieces of the cancer puzzle when combined with clinical insights.

A molecular pathway is a series of interactions between molecules in a network that lead to a change in the state of the cell. Such a pathway can trigger the assembly of new molecules, such as a fat or protein, or it can turn genes on and off, or prompt a cell to move.

All parts of the human body, from individual cells to entire organs, must work together to promote normal development and function and so sustain health. This feat of biological teamwork is made possible by an array of intricate, interconnected pathways that facilitate communication among genes, molecules and cells. It is critical to fully understand the molecular and cellular mechanisms of biological pathways to develop effective treatments, preventative agents, and diagnostic and prognostic markers.

To reach this goal, the Center for Biological Pathways coordinates the interaction of Center members, all of whom work to unravel novel molecular and cellular pathways within their

oncologic specialty. This coordination expedites the translation of laboratory discoveries into clinical research. The Center provides state-of-the-art shared resources and an intellectual environment in the form of seminars and retreats to facilitate interactions, stimulate genius, and expedite research outcomes.

Website: <http://www.mdanderson.org/cbp>

Center for Biomolecular Structure and Function

The mission of the Center for Biomolecular Structure and Function (CBSF) is to provide a focal point, scientific expertise and resources to researchers allowing the understanding of the underlying biochemical, chemical and structural mechanisms of complex biological processes.

Typically the CBSF serves basic scientists and clinicians from MD Anderson, the Texas Medical Center and the wider Gulf Coast Consortia, an organization of several local research institutions promoting collaborative research.

Goals of the CBSF

- To transform the scientific understanding of biological problems to incorporate the detailed mechanistic understanding that results from structural and biophysical data input.
- To allow collaborating scientists to undertake high risk, high reward projects with minimal negative consequences to their research programs.
- To serve as a mechanism to attract outstanding structural biologists/biophysicists, chemists and biochemists to MD Anderson and the Texas Medical Center.
- To enhance the reputation of MD Anderson (and the Texas Medical Center) basic science and to bring recognition to the institutions involved regarding their involvement in cutting edge, high profile structure-chemistry-function studies.

Website: <http://www.mdanderson.org/cbsf>

Center for Cancer Epigenetics

The Center for Cancer Epigenetics (CCE) brings together faculty members focused on epigenetics, the study of heritable and acquired changes that affect gene expression and cellular differentiation without DNA sequence alteration. Epigenetic changes are now thought to be just as important as gene mutations in cancer development. The ultimate goal of the center is to define the full spectrum of epigenetic changes that occur in cancers, to discover the molecular causes of these changes, and to translate that newly gained knowledge into the clinic in the form of novel, epigenetic based therapies. Members of the center include faculty from several basic research and clinical departments at MD Anderson, including our Smithville campus, as well as Baylor College of Medicine.

Website: <http://www.mdanderson.org/cancer-epigenetics>

Center for Cancer Immunology Research

The Center for Cancer Immunology Research (CCIR) is a one of a kind research program where laboratory and clinical immunologists work side by side to translate groundbreaking discoveries in basic immunology into the development of innovative immunotherapies that instruct our immune system to eliminate cancer and prevent its recurrence.

Since the center's inception in 2003, CCIR investigators have made remarkable progress in the number of high-quality publications, level of research support, and number of investigator-initiated pre-clinical studies/clinical trials.

Website: <http://www.mdanderson.org/ccir>

Center for Environmental and Molecular Carcinogenesis

The Center for Environmental and Molecular Carcinogenesis (CEMC) provides state-of-the-art technologies and an intellectual framework to foster multidisciplinary research into the environmental, genetic and epigenetic factors that influence the initiation and progression of cancer. Environmental factors, which include diet and other lifestyle factors, are known to be involved in the etiology of most cancers. Aims of the CEMC are to define the step-wise molecular and cellular alterations that occur during the process of carcinogenesis; determine how environmental exposures cause key genetic mutations and epigenetic changes that underlie carcinogenesis, and discover the impact of environmental factors on the generation and maintenance of cancer stem cells. The overall goal of this research is to identify new targets and strategies for cancer prevention and treatment. This center fosters collaborations among researchers at the MD Anderson Smithville and Houston campuses.

Website: <http://www.mdanderson.org/cemc>

Center for Genetics and Genomics

The Center for Genetics and Genomics is an emerging center focused on our goal to establish critical mass and synergy in genetics and genomics research at MD Anderson.

One of the mechanisms to accomplish this is to bring together researchers to present and discuss current research, exchange ideas for future funding and goals, including the development of much-needed genomics core facilities, and to disseminate pertinent data and genetic models that emphasize MD Anderson's unique research environment. Members are asked to attend regular meetings and to present current work in this setting.

The Center for Genetics and Genomics is one of seven centers within the Institute for Basic Science at MD Anderson. Each center, including the Center for Genetics and Genomics, works on a research theme that encourages participation and interaction among basic, translational and clinical faculty members. One of the first tasks for this center is to identify MD Anderson faculty who have interests and wish to play an active role in establishing and maintaining center activities.

Website: <http://www.mdanderson.org/cgg>

Center for Inflammation and Cancer

The Center for Inflammation and Cancer (CIC) was established in late 2008 and is one of several interdisciplinary research centers in the MD Anderson Institute for Basic Science. Inflammation has been closely linked with various cancers. The goal of the CIC is to provide an interactive platform across MD Anderson and the Texas Medical Center to study cross-regulation of inflammatory cell types and tumor microenvironments and the underlying molecular mechanisms using both animal models and patient samples.

Website: <http://www.mdanderson.org/cic>

Center for RNA Interference and Non-Coding RNAs

The Center for RNA Interference and Non-Coding RNAs (RNA Center), established under the Red and Charline McCombs Institute for the Early Detection and Treatment of Cancer, is a unique collaborative initiative among MD Anderson Cancer Center, Baylor College of Medicine, the University of Texas Health Science Center at Houston, Rice University and the University of Houston that will focus on gaining insights into the roles of newly discovered RNAs in cancer initiation, progression and dissemination.

Website: <http://www.mdanderson.org/rnacenter>

Center for Stem Cell and Developmental Biology

The Center for Stem Cell and Developmental Biology (CSCDB) provides a platform for interactions between researchers interested in the biology of normal and aberrant (cancer) stem cells, regeneration and differentiation. The members of the center take diverse approaches toward a thorough understanding of stem cells, with an ultimate goal of therapeutic attack on cancers. These efforts are not limited to the 40-plus laboratories across 15 different departments of the UT MD Anderson Cancer Center, but are being coordinated across the Texas Medical Center to include researchers at Baylor College of Medicine and the Institute for Molecular Medicine, as a HouSTEM community.

The Center for Stem Cell and Developmental Biology has three major goals: to understand how tumor-derived stem cells become aggressive cancers, to develop stem cells for use in regenerative therapies, and to determine basic mechanisms of differentiation and development.

Website: <http://www.mdanderson.org/scdb>

Center for Targeted Therapy

The center's goal is to produce or identify drugs that treat the carcinogenic, genetic and molecular changes that lead to cancer. The Department of Experimental Therapeutics, the building block for the new program, is already working on a number of new chemotherapeutic and biologic agents and novel therapies.

The Next Frontier—Drugs for Cancer Prevention: The designer drugs produced by this team of 15 scientists will attack defects in cancer cells and in pre-cancerous cells. Molecular and genetic defects in cancer cells can reveal targets specific to each patient, which will be the object of drugs designed to destroy the malignant cells. These targets will also be the next frontier in cancer prevention, allowing physicians to correct or destroy cells with defects before they become a health threat.

A Head Start Advantage: Progress in technologies such as genomics and proteomics and sophisticated bioinformatics analyses has provided the tools and knowledge needed to enhance the design and application of novel cancer therapeutics.

Some of the genetic "abnormalities" found in individual tumors and blood can serve as "cancer markers" that will help researchers identify the genetic profile of each patient's cancer and develop an individualized approach that will be both more effective and less toxic.

Website: <http://www.mdanderson.org/ctt>

Duncan Family Institute for Cancer Prevention and Risk Assessment

The Duncan Family Institute for Cancer Prevention and Risk Assessment, formed in 2008 through a generous gift from the Duncan Family, is advancing the science and practice of cancer prevention by accelerating the discovery and translation of new knowledge about cancer risk factors and developing innovative ways to reduce risk and prevent cancer while expanding our studies to attack multiple risk factors using complementary strategies. The Duncan Family Institute serves to foster collaboration aimed at breaking new ground in cancer prevention. Scientists affiliated with the Institute are discovering the roles and effects of the interaction of biologic, genetic, environmental, behavioral and social factors in cancer development, investigating new medical and lifestyle interventions and the effect of the combination of these on reducing cancer risk, and increasing the pace of translation of discovery to the clinic and the community so that, ultimately, the benefits of our discoveries help reduce the overall burden of cancer.

The Duncan Family Institute will further enable MD Anderson to:

- Become the world's premier center committed to cancer prevention research and practice with a specific goal of reducing the morbidity and mortality of cancer and its treatment.
- Emerge as a definitive resource for educating the public and health care professionals about state-of-the-art practices in cancer prevention, the critical role that research plays in advancing knowledge and increasing our ability to offer better options tomorrow.
- Train future generations of researchers and practitioners committed to cancer prevention and to the broader mission of improving and sustaining health.

The singular motivation driving this vision is a shared commitment to improve the outlook for those at increased risk for cancer, cancer survivors, their families and the general public. The Institute will foster a unique environment that attracts and retains multidisciplinary teams of world-class faculty and staff experienced in pursuing basic, translational, and clinical science to achieve two interrelated goals:

1. Making scientific discoveries focused on the earliest stages of cancer development, mindful of their potential applications to later stage cancers as well.
2. Translating those discoveries into new tools and novel applications of existing tools that can be used to reduce the burden of cancer and advance public health, while simultaneously probing the cascade of discovery questions generated by research.

With one of the premier cancer prevention programs in the world, the researchers and physicians of the Division of Cancer Prevention and Population Sciences are dedicated to increasing the nation's focus on cancer prevention. Research in behavioral science, epidemiology and chemoprevention are rapidly increasing the possibilities of preventing even more cancers. This powerful partnership will provide seed funding for promising new projects to accelerate the pace of discovery and the translation of findings to the clinic and community. Together, MD Anderson and the Dan L. Duncan Family Foundation will inspire scientific discoveries that may be translated into real-world changes and reduce the burden of cancer on individuals, families and society.

Website: <http://www.mdanderson.org/duncanfamilyinstitute>

Institute for Applied Cancer Science

MD Anderson is known for providing cancer patients with exceptional care, which includes early access to innovative new treatments through clinical trials. The Institute for Applied Cancer Science (IACS) is a new hybrid model that uniquely combines the drug discovery capabilities of the biopharmaceutical industry and the extensive knowledge of biology found in academia with the expertise of MD Anderson's top clinicians to develop new therapeutic options.

IACS has the singular goal of rapidly developing novel, effective and safe therapeutics that improve patient health. Close collaborations with the physician scientists here at MD Anderson helps to position these therapeutics to benefit specific patient populations with unmet medical need.

IACS executes programs with the highest probability of clinical success in a rigorous, goal-oriented, data-driven manner. Employing the Bench at the Bedside approach IACS uniquely integrates three key components:

- Access to insights gained from the largest set of cancer patients and some of the best physician scientists in the nation
- Highly experienced team of drug discovery and development scientists
- Clinically informed, patient-oriented research focused on the endpoint of delivering impactful clinical responses

Website: <http://www.mdanderson.org/applied-cancer-science>

Institute for Basic Sciences

MD Anderson Cancer Center promotes a nurturing environment to enhance collaboration among clinicians, physician scientists and basic scientists.

To that end, the Institute for Basic Sciences was established in 2008. The goal of the Institute is to accelerate scientific discoveries by recruiting outstanding laboratory scientists and creating a collaborative environment in which our faculty have access to state-of-the-art core facilities and participate in theme- and/or disease-oriented symposia and retreats. The Institute serves as a catalyst for faculty to exchange ideas and to solve critical problems that apply to fundamental aspects of cancer biology and lead clinical aspects in treating patients.

In the few years since its launch, the Institute has consistently grown and flourished. Through various recruitment packages affiliated with the Cancer Prevention Research Institute of Texas (CPRIT) and funding from the University of Texas Science and Technology Acquisition and Retention (STARs) program, all affiliated centers continue to actively recruit faculty at all levels to enrich the centers' research programs.

The vision of the Institute is to promote basic science research at MD Anderson to world-renowned recognition. Investigators focus on tackling basic fundamental puzzles in cancer biology. Their findings could lead to clinical aspects in treating cancer patients.

The director, co-directors and members of the Centers for Research Excellence are faculty in basic science departments at MD Anderson, including the Departments of Biochemistry and Molecular Biology, Cancer Biology, Carcinogenesis, Genetics, Immunology, and Molecular and Cellular Oncology. To enhance our interactions with other centers and institutes at MD

Anderson, these directors meet quarterly with the Metastasis Research Center, the Center for Advanced Biomedical Imaging Research at the McCombs Institute, the Cancer Genome Atlas (TCGA) Genome Data Analysis Center, and the animal facility.

Institute investigators are also actively involved in graduate education programs at The University of Texas Graduate School of Biomedical Sciences (GSBS) at Houston – a joint program between The University of Texas Health Science Center at Houston (UTHealth) and MD Anderson Cancer Center -- ranked among the best in the nation in the 2009 National Research Council assessment. Among 123 programs in the category of Cell and Development Biology, the Ph.D. Cancer Biology Program was ranked second (along with Harvard, Johns Hopkins and Stanford University), and the Genes and Development Program was sixth. Many faculty members in the IBS are an integral part of the two programs.

Website: <http://www.mdanderson.org/basicsci>

The Institute for Cancer Care Excellence

The Institute for Cancer Care Innovation studies new and existing models of cancer care delivery and reimbursement. Its programs are based around the principles of value-based health care delivery that focuses on the outcomes and costs of care. The Institute, formerly known as the Institute for Cancer Care Excellence, was created in 2008 to demonstrate the value of MD Anderson's research-driven multidisciplinary care. The Institute has been at the forefront nationally and internationally for its innovative approaches to measurement of the value of our cancer care delivery system.

With programs designed to measure the outcomes and costs of the care we provide, the Institute provides essential strategies for maintaining MD Anderson's preeminent position as the nation's No. 1 provider of cancer care in the United States.

Key Initiatives

- Evaluating which value-based outcomes are most important to cancer patients and identifying which outcomes measures are significant for patients and providers
- Using TDABC and new costing methodologies to better assess value at MD Anderson Cancer Center
- Creating proposed bundled payments for major disease types in order to meet a changing health care reimbursement landscape
- Fostering the better use of electronic medical records and electronic health records for both patients and providers

- Integrating more useful and comprehensive electronic medical and health data into cancer care
- Working toward incorporating technology into patient experiences to provide better communication between patients and their families and providers

Website: <http://www.mdanderson.org/education-and-research/research-at-md-anderson/cancer-care-innovation/index.html>

Institute for Personalized Cancer Therapy

The MD Anderson Cancer Center Sheikh Khalifa Bin Zayed Al Nahyan Institute for Personalized Cancer Therapy was created to support preclinical research and clinical trials in which a patient's tumor biopsy is assayed for abnormal genes and gene products to select therapy with agents targeting the product of those particular abnormal genes. This integrated research and clinical trials program is aimed at implementing personalized cancer therapy and improving patient outcomes. A number of events have converged creating a "perfect storm" offering the opportunity to make a bold leap forward in personalizing cancer care. Personalized cancer therapy includes all aspects of individualized patient management driven by characterization of tumor, microenvironment and host characteristics including diagnosis, surgery, chemotherapy, targeted therapy, radiation therapy, and immunological manipulation either alone or in concert.

Mission

The MD Anderson Cancer Center Sheikh Khalifa Bin Zayed Al Nahyan Institute for Personalized Cancer Therapy will provide personalized cancer therapy for all of our patients and define the new standard of patient care by improving outcomes and reducing costs.

Vision

We will be the leader in implementing personalized cancer therapy, based on an analysis of each patient's cancer that will integrate information across DNA, RNA, proteins and metabolomics in the context of the tumor microenvironment and the patient's immune system.

Strategic Plan

Our strategic plan for the Institute is focused on the goal of defining the new standard of patient care – making personalized cancer therapy standard over the next 5 years, revolutionizing the way we manage patients. To accomplish this goal, we will:

- 1) Rapidly implement the expanded molecular pathology laboratories, technology, instrumentation, and infrastructure for personalized clinical trials;
- 2) Develop best practices for obtaining and managing patient biopsies and specimens to implement personalized cancer therapy;
- 3) Position MD Anderson to lead the way in therapeutic clinical trials based on the underlying genomic and molecular alterations in individual patient's cancers; and
- 4) Establish broad internal and external collaborations and partnerships to enhance our ability to rapidly transform discoveries into clinical practice and standard of care.

Website: <http://www.mdanderson.org/ipct>

McCombs Institute

Red and Charline McCombs and their daughters, Marsha, Connie, and Lynda, have given cancer researchers a tool for scientific discovery that has great promise to accelerate the rate at which new patient-focused advances are made. To thank them for their generosity, the institute was named in their honor.

A New Approach

Established more than three years ago, the McCombs Institute brings together leaders in biomedical research to focus on molecular-based approaches to cancer diagnosis and management.

The research centers in the McCombs Institute and throughout MD Anderson are generating vast amounts of data on the relationships of specific genes and gene abnormalities with the development and progression of specific cancers. This data, coupled with the expertise and analysis provided by our [Division of Quantitative Sciences](#), is enabling identification of critical steps in the cancer development process and the development of new diagnostic tests and cancer drugs to target them.

The McCombs Institute is bringing together thought leaders in six key areas of biomedical research to focus on molecular-based approaches to cancer diagnosis and treatment.

Hundreds of researchers are interacting for a common purpose:

- Samir Hanash, M.D., Ph.D., Director, Red and Chaline McCombs Institute for the Early Detection and Treatment of Cancer
- Metastasis Research Center – Raghu Kalluri, M.D., Ph.D.
- Center for cancer Immunology Research – Patrick Hwu, M.D. and Larry Kwak, M.D., Ph.D.
- Center for Radiation Oncology Research – TBD
- Center for Advanced Biomedical Imaging – Marshall Hicks, M.D.
- Center for Targeted Therapy – Varsha Gandhi, Ph.D.
- Center for RNA Interference and Non-coding RNAs – Anil Sood, M.D. and George Calin, M.D., Ph.D.

Website: <http://www.mdanderson.org/education-and-research/departments-programs-and-labs/programs-centers-institutes/mc-combs-institute-for-the-early-detection-and-treatment-of-cancer/index.html>

Metastasis Research Center

The Metastasis Research Program (MRP) is a component of the NIH Cancer Center Support Grant, designed to advance knowledge and research in the field of Metastasis Research. The Metastasis Research Center (MRC), supported by MDACC, is a multidisciplinary research center run in parallel to MRP. The MRP/MRC consists of 30+ members from diverse departments contributing their knowledge to the field of metastasis biology. All major tumor sites are included in the MRP/MRC and members of the MRP/MRC are also members of other centers and programs throughout the institute; this leads to cross-fertilization of ideas and resources.

The main objectives of the MRP/MRC are to 1) provide educational opportunities in the biology of metastasis, and 2) to provide support for novel research ideas. The MRP/MRC sponsors an annual retreat that is held in early December of each year. The retreat includes presentations from members of the MRP/MRC as well as recipients of grant funding provided by the MRC. The day culminates with the annual Fidler Lectureship in Metastasis Biology that will be selected by

members of the MRP/MRC.

In addition, the MRC supports two grant-funding opportunities per year (April and October). Each request for applications (RFA) will be thematic, addressing a distinct area of metastasis research. These grants will be provided for 1-2 years of support with the provision that the recipients of the grant will use these funds to generate preliminary data to support the subsequent submission of an R01 (or equivalent) grant.

The MRP/MRC will consist of subthemes including: 1) the tumor microenvironment, 2) genomics and genetics of metastasis, and 3) cancer stem cells and EMT. Small working groups will meet to discuss strategies to advance the field in these particular areas. In addition, each section of the MRP/MRC will alternate in leading Institutional Grand Rounds every 6 months. Website: <http://www.mdanderson.org/metastasis>

Proton Therapy Center

Proton therapy benefits patients whose tumors are solid with defined borders, meaning the cancer has not spread to other parts of the body. The noninvasive treatment does not require surgery to remove the cancer, making it ideal for inoperable tumors.

The advantage of proton treatment is that the physician can control where the proton releases the bulk of its cancer-fighting energy. As the protons move through the body, they slow down and interact with electrons, and release energy. The point where the highest energy release occurs is the "Bragg peak." A physician can designate the Bragg peak's location, causing the most damage to the targeted tumor cells. A proton beam conforms to the shape and depth of a tumor, while sparing healthy tissues and organs.

How Does it Work?

The best way to understand how proton therapy works is to take a look at the physics and engineering inside the proton accelerator, or the synchrotron, and the beam delivery system.

- The proton begins its journey at the ion source. Within fractions of a second, hydrogen atoms are separated into negatively charged electrons and positively charged protons.
- The protons are injected via a vacuum tube into a linear accelerator and in only a few microseconds, the protons' energy reaches 7 million electron volts.
- Proton beams stay in the vacuum tube as they enter the synchrotron, where acceleration increases their energy to a total of 70 million to 250 million electron volts, enough to place them at any depth within the patient's body.
- After leaving the synchrotron, the protons move through a beam-transport system comprised of a series of magnets that shape, focus and direct the proton beam to the appropriate treatment room.
- To ensure that each patient receives the prescribed treatment safely and efficiently, the facility is controlled by a network of computers and safety systems. The gantry can revolve 360 degrees, allowing the beam to be delivered at any angle.
- As protons come through the nozzle, a custom-made device (the aperture) shapes the beam of protons, and another custom-made device (the compensator) shapes the protons into three dimensions, delivering them to the depth of the tumor.
- At maximum energy, a proton beam travels 125,000 miles per second, which is equivalent to the two-thirds the speed of light.
- From the hydrogen canister to the patient, a proton typically travels 313,000 miles.

Pencil Beam and Intensity Modulated Proton Therapy

The team at MD Anderson Proton Therapy Center continues to expand ways to use proton therapy to benefit patients. The team pioneered **pencil beam proton therapy**, also called scanning beam, and intensity modulated proton therapy (IMPT). We are one of the few centers worldwide offering these types of proton therapy to our patients.

Pencil beam technology and IMPT build on the benefits of proton therapy. With a proton beam just millimeters wide, these advanced forms of proton therapy combine precision and effectiveness, offering unmatched ability to treat a patient's tumor and minimizing effect on a patient's quality of life – during and after treatment. They rely on complex treatment planning systems and an intricate number of magnets to aim a narrow proton beam and essentially “paint” a radiation dose layer by layer.

Pencil beam is very effective in treating the most complex tumors, like those in the prostate, brain, eye, and cancers in children, while leaving healthy tissue and other critical areas unharmed. IMPT is best used to deliver a potent and precise dose of protons to complex or concave-shaped tumors that may be adjacent to the spinal cord or embedded head and neck or skull base, including nasal and sinus cavities; oral cavity; salivary gland; tongue; tonsils; and larynx.

Website: <http://www.mdanderson.org/proton>

Robert J. Kleberg, Jr. & Helen C. Kleberg Center for Molecular Markers

Early diagnosis and personalized treatment: The overall research objective of the Robert J. Kleberg, Jr. & Helen C. Kleberg Center for Molecular Markers will be to identify the molecular markers that will allow a cancer specialist to diagnose cancer early and predict response to a particular treatment. The plan is to eventually be able to create a personalized treatment for each individual patient.

Analysis of the DNA, RNA, and proteins of tumors: A major focus of the research will be to characterize the molecular changes in cancer patients' tumors by analyzing DNA, RNA and proteins in the tumors and also in the blood. Molecular markers will help identify those at risk for cancer and provide information for screening and prevention measures. Doctors will also use the markers to select the best treatment with the fewest side effects for each patient.

Applications for all cancers: “What we learn about molecular markers in lung cancer may be translated to breast cancer. This program is not disease-site specific. In fact, we believe the research can impact a variety of cancers.

What's already happening? A research team found a potential new protein marker of the prognosis of breast and ovarian cancers. Tumor cells with an abundance of the protein Rab25, the researchers found, are more aggressive and associated with poorer outcome. Thus, Rab25 could become a target for cancer treatment.

Website: <http://www.mdanderson.org/kleberg>

MD ANDERSON SHARED RESOURCES

Cancer Center Support Grant Shared Resources Bioinformatics

Summary

The Bioinformatics Shared Resource (BISR) provides consultation, collaboration, and support for researchers and core facilities throughout MD Anderson in the statistical analysis and biological interpretation of data from high-throughput pre-clinical technologies. This resource operates out of the Section of Bioinformatics in the Department of Biostatistics. Although the first faculty members were recruited in 1999, the Bioinformatics Section itself was formally created in October 2000 as a joint effort of the Biostatistics Department and the Cancer Genomics Program. The BISR has specialist expertise in the bioinformatics of all types of microarrays, next-generation sequencing, mass spectrometry, and flow cytometry. It is now easier, and often cheaper, to generate millions of data points on the molecular profiles of cancers than it is to analyze those data points statistically or interpret them biologically. With the revolution in DNA and RNA sequencing, the need for bioinformatics support throughout MD Anderson has increased exponentially, and the BISR is the institution's principal resource for dealing with this data deluge. The BISR uses a heterogeneous computing environment supported across Windows, Unix/Linux, and Mac OS X operating systems, with access to more than 300 terabytes of in-house storage space for home directories, research data, and data mirrors. It accesses in-house parallel computing capability through a 48-processor Cray XD1 HPC cluster and a 290-processor distributed computing Condor pool of over 160 Windows workstations (each with ≥ 2 GB of memory) and 8 servers (ranging from 4GB to 16GB of memory).

Biostatistics Resource Group

Statistical Consulting

A shared resource providing statistical collaboration and consultation to research scientists. The goal is to develop statistical designs for trial conduct and to provide data analysis of current and future therapeutic, diagnostic, prevention and intervention studies, while also improving the patient care that is provided through clinical trials.

Numerical Computing

A shared resource supporting the Bayesian statistical computing needs of MD Anderson Cancer Center.

Database Development

A shared resource supporting academic and research computing through database design, development and administration, including systems providing automated extraction and transfer of information from clinical databases to research databases.

Characterized Cell Line Core Facility

About Cell Line Validation

Between 18 and 36% of cell lines are either misidentified or cross-contaminated¹. In the NCI60 set, three lines are duplicates (MDAMB435/M14, MCF7-ADR/OVCAR8 and U373/SNB1.9). Genetic drift has introduced mutations in key regulatory pathways, leading to contradictory results from different laboratories. A recent notice from NIH requires cell line validation f

or grant applications to be considered of the highest quality². Journals such as Science, Nature and PNAS are adopting requirements for cell line validation for publication. Cell lines that have been extensively characterized at the DNA, RNA and protein levels will allow investigators to choose the correct cell line for their research. Pre-characterized cell lines will decrease the cost to researchers since this will eliminate repeat analysis. Thus, cell line validation is a critical issue for both scientific publications and grant applications.

Clinical & Translational Research Center

The Clinical and Translational Research Center (CTRC), created in 1990, is MD Anderson's dedicated unit in which to: Conduct early phase, complex, new drug research and develop new agents for the treatment of cancer and related diseases. CTCRC is an on-site resource for M.D. Anderson investigators performing early clinical trials and where patients receive intensive monitoring for complex, early-phase clinical trials. A team of outstanding nurses, clinical, and laboratory staff implement CTCRC-approved protocols. The CTCRC is 8,600 square feet with 18 treatment rooms.

Physician-scientists working on the development and evaluation of new agents for cancer treatment will find the CTCRC an especially important resource. Services include:

- Coordination of multidisciplinary research
- Intensive, time-sensitive monitoring of patients
- Phlebotomy team and adjoining laboratory for prompt specimen processing
- Storage, tracking and shipment of specimens
- Coordination and communication with referring physicians

The CTCRC Laboratory is housed within the CTCRC unit to provide sample collection, processing, storage, and shipping to conduct pharmacology studies. Clinical investigation technicians collect and process blood and urine specimens for clinical trials.

Clinical Trials Support Resource

Summary

In 1995, The University of Texas MD Anderson Cancer Center initiated expansion of the infrastructure supporting clinical research in the Clinical Trials Shared Resource (CTSR). This entailed consolidating a number of functions, which had been dispersed across the institution, into a single office known as the Office of Protocol Research (OPR). The resources supporting clinical trials from the following three areas were integrated: administrative support, regulatory affairs, and information technology.

e-Health Technology

Multimedia applications for research and interventions

e-Health Technology supports technology-enabled primary, secondary, and tertiary cancer prevention research through the development and implementation of multi-media intervention and data-capture tools that address research questions in the areas of 1) behavior change, 2) health information, 3) symptoms, and 4) quality-of-life. e-Health Technology-developed products deliver information to and capture data from study participants and are tailored individually, consistent with study design.

The e-Health Technology resource:

- provides the ability to reach a broad range of participants
- serves as a hub for technology-enabled research and draws investigators from across MD Anderson
- fosters collaborations among researchers from diverse disciplines
- develops technology platforms and tools to support 17 active and completed projects, contributing to more than \$20 million in research

Flow Cytometry and Cellular Imaging Core Facility

The Flow Cytometry and Cellular Imaging (FCCI) Core Facility was established in 1982 with the goal of providing the large community of investigators at MD Anderson with access to state-of-the-art cell analysis technology. The Core has expanded the number of technologies offered and in use by cancer center members. The FCCI Core now includes two separate sites: the North Campus and South Campus facilities.

Institutional needs for flow cytometry services were carefully evaluated and a decision was made to transition the operation of the South Campus Flow Cytometry and Cell Sorting Facility to an institutional core to provide the Flow Cytometry and Cellular Imaging Core with sufficient capacity needed to support the institution's investigators. Now, both the North and South Campus facilities are open to the entire MD Anderson research community.

RPPA Core Facility - Functional Proteomics

Reverse phase protein array (RPPA) is a high-throughput antibody-based technique developed for Functional Proteomics studies to evaluate protein activities in signaling networks. The RPPA Core provides services to perform such an assay for your studies.

Features of RPPA

- Cost effective
- High throughput
- Sensitive (detects ng of proteins)
- Accurate quantification
- Applicable to small sample sizes

Genetically Engineered Mouse Facility

The purpose of the Genetically Engineered Mouse Facility (GEMF) is to provide technologically advanced and efficient mouse mutation resources to faculty members at the institution. Modifications to the genome utilizing direct DNA injection and ES cell mutagenesis, cryopreservation, in vitro fertilization and rederivation of mouse lines are all technologies supported by the facility.

The facility is fully equipped with the latest instrumentation and staffed with highly skilled personnel trained specifically for the production of mutant mice.

High Resolution Electron Microscopy Facility

The High Resolution Electron Microscopy Facility (HREMF) provides a resource to the scientific community at MD Anderson for high resolution imaging of cells, tissues, organs or polymers containing cancer agents. The facility is located at the Smith Research Building (South Campus) and houses a JEM1010 transmission electron microscope (TEM), a JSM 5900 scanning electron microscope (SEM) equipped with electron backscatter detector, a Technotrade coating system, a Leica Ultramicrotome, Leica Ultrastainer and other accessories needed to prepare samples for SEM and TEM. A technician with histology training is available to assist researchers in defining their specific needs related to SEM and TEM. Microscopes are equipped with digital cameras and CD burners, and are connected to a network printer and the Internet. The facility operates on a charge-back basis only for processing of samples and the number of microscope hours used to screen samples with technical assistance.

Education

A detailed set of protocols is provided to the investigator regarding the preparation of samples for SEM and TEM. In the majority of cases the investigator fixes the sample with fixative prepared by HREMF staff and HREMF staff performs subsequent processing. Screening of samples with the assistance of technical support is recommended at all times. Background references on the particular investigation are usually requested by HREMF to ensure that the correct fixatives and specific information regarding the specimen is known before the analysis.

Monoclonal Antibody Core Facility

The Monoclonal Antibody Facility (MABF) provides custom monoclonal antibody production and purification to researchers at MD Anderson and beyond.

The main focus of the facility is to produce high-affinity antibodies in a high-throughput and effective manner, while concentrating on quality of product and service, as well as saving time and money for potential users.

What Are Monoclonal Antibodies?

In the early 1970s, the idea of producing identical antibodies specific to a given antigen started to arise among the scientific community. It was successfully accomplished when Georges Köhler, César Milstein and Niels Kaj Jerne created the process of producing monoclonal antibodies in 1975. They shared the Nobel Prize in Physiology or Medicine in 1984 for the discovery.

By definition, “monoclonal antibodies (mAb) are antibodies that are identical because they were produced by one type of immune cell and are all clones of a single parent cell. Given (almost) any substance, it is possible to create monoclonal antibodies that specifically bind to that substance; they can serve to detect or purify that substance.”

The key idea was to use a line of myeloma cells that had lost their ability to secrete antibodies, come up with a technique to fuse these cells with healthy antibody producing B-cells and be able to select for the successfully fused cells. mAbs have become an essential tool in biochemistry, molecular biology and medicine. Basic and clinical researchers have been taking advantage of them for a wide range of uses.

Mutant Mouse Pathology Service

The Mutant Mouse Pathology Service (MMPS) provides investigators with expert experimental pathology support. MMPS staff consult with investigators to formulate an integrated imaging, pathology and histology protocol for each study, with the goal of assuring customized, efficient and comprehensive data collection.

The IVIS Spectrum in vivo imaging system, recently funded by a CPRIT Shared Instrumentation Award, is supported through this core. The MMPS also recently acquired the VetScan2 and HemaVet 950S instruments for determining clinical chemistry and hematology parameters, respectively, using very small volumes of blood. MMPS staff provide expert interpretation of experimental lesions and development of new methods as needed to support the investigations of departmental scientists.

Nuclear Magnetic Resonance Facility

The NMR facility houses two state-of-the-art spectrometers for use in the determination of the structure of small molecules and biological macromolecules, reaction kinetics, macromolecule dynamics, metabolism, etc. Samples are analyzed either by individual users or by the facility manager.

Patient-Reported Outcomes, Survey and Population Research (PROSPR)

The Patient-Reported Outcomes, Survey & Population Research (PROSPR) Shared Resource provides researchers with access to state-of-the-art patient-reported outcome (PRO), quality of life, psychological and behavioral questionnaires and assessment methods. Our services include assisting investigators in identifying existing measures, developing new measures and designing data collection strategies and conducting psychometric analysis. The PROSPR Shared Resource will also develop databases for the questionnaire data entry, participant tracking databases and computer- and Web-based assessments. If you have technological needs pertaining to the development of applications or programs, multimedia platforms (i.e., mobile devices, Web sites, video, animation, etc.), we can assist you through our partnership with e-Health Technologies. Additionally the PROSPR Shared Resource maintains a library of existing questionnaires, along with information pertaining to their reliability, validity and scoring.

Research Animal Support Facility - Houston

The Research Animal Support Facility in Houston (RASFH) exists to serve the research programs of MD Anderson. The Department of Veterinary Medicine and Surgery (DVMS) is the core of the RASFH. Our primary mission is to provide the best possible veterinary care, facilities and services in support of the Institutional Animal Care and Use Program, in keeping with all applicable laws, regulations, guidelines, and AAALAC accreditation standards. The focus of the RASFH is the well-being of all animals, the best interests of our researchers, and the best interests of MD Anderson and its Animal Care and Use Program. As the institution's research mission evolves and new animal research needs are identified, RASFH personnel identify new opportunities to participate in additional research support activities. Presently, the use of transgenic, SCID, and targeted mutant (knockout) mice and the associated new molecular programs represent such activities.

The RASFH consists of 3 centralized animal facilities providing housing for a wide variety of species. Housing types include barrier, conventional, quarantine, and containment. Extensive

procedure room space and specialty research services exist to support ongoing research programs. We maintain PHS Animal Welfare Assurance approval (A3343-01), and are registered as research animal facilities in good standing with the United States Department of Agriculture (USDA) (74-R-065). Our facilities have maintained full accreditation by the Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) since 1969.

Clinical and basic cancer research involving laboratory animals is conducted at MD Anderson. Improved cancer treatments involving chemotherapeutic and immunologic agents, surgical procedures, radiotherapy and combinations of these treatments are being developed using laboratory animals. Basic cancer research is conducted in support of patient care in the above areas as well, but also includes other animal use areas such as cancer biology, genetics, biochemistry, molecular therapeutics, immunology, pathology, pharmacology, biomathematics, neurology, anesthesiology, and veterinary medicine and surgery. The predominant use of animals addresses the questions about the causes, diagnosis, treatment, and prevention of cancer in humans. Basic and clinical research activities are involved and may be closely related.

Research Animal Support Facility - Smithville

The Research Animal Support Facility in Smithville (RASFS) provides support for animal-based research at MD Anderson Science Park Research Division (SPRD), Department of Carcinogenesis. Located in central Texas near Austin, the AAALAC-accredited RASFS is 150 miles from the main MD Anderson complex in Houston. RASFS investigators use primarily rodent animal models, i.e., mice, rats and hamsters, and over 200 mutant, transgenic and knockout rodent lines are maintained in the RASFS. Included among these are models manifesting cancers of the prostate, mammary gland, uterus (fibroid), kidney, head and neck, skin (including the Xiphophorus fish melanoma model), biliary tract, urinary bladder and lymphoreticular system.

The 30,000-square-foot RASFS is operated as a modified barrier and provides animal husbandry for conventional and immunosuppressed rodents, veterinary care and consultation, surgical and technical support, necropsy, radiation (X-ray or UV), chemical carcinogen or infectious biohazard exposure and numerous research and diagnostic services. We also provide animal health quality assurance testing, import/export services, embryo transfer rederivation, and custom breeding colony management. Genetic Services, Transgenic Services and Mutant Mouse Pathology Services are also housed in the RASFS.

- Genetic Services provides MD Anderson investigators with cost-effective, customized genome scans, using polymorphic genetic markers, to support speed congenic development, background strain characterization, genetic quality control and genetic linkage analysis for mice and rats. Consultation on rodent genetics is also provided by this component.
- Transgenic Services provides investigators with a cost-effective means of developing genetically engineered animal models. Services include generation of transgenic mouse founders and chimeric mice, rederivation and archival storage of frozen embryos and sperm. Consultation and technical support is also provided by the component.
- The Mutant Mouse Pathology Service provides MD Anderson investigators with cost-effective anatomical pathology assistance, including gross necropsy and histopathology performed by experienced veterinary pathologists. Consultation on animal models selection and validation is also provided.

Research Histopathology Facility

At MD Anderson, peer-funded research projects that require histologic analysis have been provided with slide preparation by a shared resource facility since 1981. The Research Histopathology Facility (RHF) supplies technical support and consultation, develops and applies appropriate technologies, and maintains the consistency and high quality necessary to perform these techniques. In addition to standard histologic techniques, the spectrum of services provided by the RHF has been continually broadened to meet the requirements of MD Anderson investigators. This expansion of service includes an increase in special stains, frozen sectioning, RNase procedures and immunohistochemical staining and preparations.

The expansion of translational research at MD Anderson has led to increased use of the RHF for various histologic techniques involving human tumor and control specimens, including routine use of microdissection to enrich specimens for tumor cells for laboratory analysis. After Dr. Stanley Hamilton was recruited to MD Anderson in 1998, he established the policy that surgical pathology blocks remain under the direct control of the Department of Pathology and are released for research purposes only to pathologists in the department. As a consequence, the RHF assumed an important new role in providing diagnostic patient specimens for research. Research requests for use of blocks in the files of the Department of Pathology are received in the pathology file room. Surveillance Committee (institutional review board) approval for the study is verified with the signature of the responsible investigator, and the blocks are then retrieved from the Department of Pathology file room and/or warehouse. These blocks are then transferred directly to the RHF for logging of the blocks and sectioning according to investigators' requests. The blocks are then returned from the RHF directly to the Department of Pathology file room. This mechanism has been successful in markedly decreasing the attrition of diagnostic blocks while maintaining support for research. The Research Histopathology Facility plays a crucial role in tracking specimens while at the same time meeting the researchers' needs for histologic material to be used in laboratory research.

Sequencing and Microarray Facility (SMF)

Core Lab Consolidation

The CCSG-supported Genomics Facility (GF) and the DNA Analysis Facility (DAF) have consolidated their activities to form a comprehensive institutional genomics shared resource: the Sequencing and Microarray Facility. (SMF)

Mission

The mission of the consolidated Sequencing and Microarray Facility is to support genomics research at MDACC by providing investigators with access to state-of-the-art instrumentation and a high level of technical expertise in a centralized facility, thereby minimizing the duplication of expensive equipment, maintaining technical excellence and enhancing research collaborations. The facility's primary focus is sequencing and microarray technologies.

The consolidated facility has combined the expertise of two existing facilities to provide investigators with:

Sequencing Services:

- Next Generation Sequencing
- Sanger DNA Sequencing
- Gene Resequencing

Microarray Services

Target Preparation, Hybridization and Imaging on the following platforms:

Affymetrix

Illumina

Other SMF Services

Sample Quality Check (DNA and RNA)

Fluorescent Fragment Analysis

Project Consultation

In addition to the standard services, the SMF provides custom services tailored to the individual needs of the investigator. Custom services include project design and technology consultations, assay design and optimization and assistance with result interpretation.

shRNA and ORFeome Core

shRNA and ORFeome Core

The discovery of short hairpin RNAs (shRNAs) suppressing gene expression in mammalian cells enables large-scale loss-of-function screens by using genome-wide shRNA libraries. Genome scale over-expression libraries allow large-scale gain-of-function screens. The ShRNA and ORFeome core makes available to the MDACC research community the human and mouse shRNA libraries, human

ORFeome collaboration and LentiORF libraries.

(<http://www.thermoscientificbio.com/openbiosystems/>). The core facility can provide individual shRNA plasmids and cDNA clones for MDACC laboratories, or carry out a screening experiment using the libraries. Purchase of clones or libraries through the shRNA and ORFeome core reduces costs and decreases turnaround time for researchers.

Small Animal Imaging Facility

The Small Animal Imaging Facility (SAIF) is a core MD Anderson research resource. It was established in 2001, became part of and is partially funded by the Cancer Center Support Grant.

The SAIF team provides comprehensive imaging support services for MD Anderson cancer investigators, including:

- Assistance in experimental design
- Developing specialty equipment and innovative procedures for imaging
- Preparing animals for studies, inducing and maintaining appropriate anesthesia and immobilization of animals during imaging
- Processing and interpreting data for publication or grant preparation

Tissue Biospecimen & Pathology Resource

The maintenance of a flexible, sophisticated institutional tissue procurement and repository facility with informatics infrastructure is vital to all aspects of current and future intra- and extramural clinical, translational, basic, and population-based research efforts at MD Anderson. The Tissue Biospecimen and Pathology Resource (TBPR) is a well-established, mature CCSG-supported core facility that provides access by all basic science, translational, and clinical investigators to human tissues that have been removed by therapeutic resection or biopsy. Benign and malignant tumor and non-neoplastic and normal control tissue from the entire spectrum of available specimens are obtained and temporarily stored. The TBPR supports hypothesis-generating, developing, and -testing studies, including both correlative and integrated marker studies in clinical trials.

The goals of the TBPR are:

- To maintain a flexible specialized tissue procurement resource that provides requesting investigators efficient and expeditious delivery of freshly-obtained, well characterized and custom-processed tumor and control tissue from patients in operating rooms, procedure rooms and clinics;
- To maintain and improve a centralized institution-wide tissue procurement and banking core facility that provides specimens according to NCI Best Practices for Biospecimen Resources and compatible with current, emerging, and anticipated methodologies for analysis of DNA, RNA and protein;
- To interface with other institutional databases to enhance the intranet-based database so it will provide epidemiology, family history, patient treatment, and patient outcome;
- To support the individual programmatically administered and funded satellite tissue banks operating within the institution, including those maintained by disease sites, SPOREs and P01s; and
- To meet the federal, state and institutional regulatory requirements for use of human tissue in research and protection of human subjects.

Great care and attention are given to the timing and documentation of acquisition, storage, cataloging, quality control/quality assurance, retrieval, and distribution of tissues to all requesting investigators. The location of the repository physically and administratively in the Division of Pathology and Laboratory Medicine under the direction of the Division Head and with the subspecialization of pathologists in disease-site orientation in the Departments of Pathology and Hematopathology provide the needed balance with diagnostic pathology.

General Information

Services of The Tissue Biospecimen and Pathology Resource (TBPR) are available to all MD Anderson Cancer Center investigators. If demand ever exceeds capacity, priority access is given to members or departments with research that is IRB approved with peer-reviewed funding, followed by members with non-peer reviewed funding. Should access become a concern, tissue bank oversight committees are responsible for convening a special meeting to review user requests and prioritize them based on such criteria as overall scientific merit, availability of external funding, technical feasibility and core resource requirements.

Translational Chemistry Core Facility (TCCF)

Prior to the initiation of any project with the Translational Chemistry Core Facility, the following issues should be explored:

- **Budget**

Prior to the submission of any grant or other funding request, investigators should obtain an estimate of costs for TCCF services. This step will prevent any differences in estimated amounts vs. awarded amounts and thereby ensure there are sufficient funds to cover work completed by the TCCF.

- **Intellectual Property, Inventorship and Royalties**

The development of new compounds or analogs of existing compounds likely will result in new intellectual property (IP). The determination of proper inventors on a patent is a legal issue that will be decided by patent counsel in light of the ultimate claims in the patent. However, if the TCCF develops new patentable drugs or analogs, the TCCF chemist and the primary investigator most likely will be joint inventors on any patent claiming such compound(s) and its applications.

- Under MD Anderson policy, the inventors on a patent share in certain licensing consideration related to that patent. Accordingly, the TCCF will determine the percentage contribution of each party on the patented invention, which also will dictate how the licensing revenue is shared between the inventors. This is typically determined at the time an invention disclosure is submitted to MD Anderson's Office of Technology Commercialization.

- The development of new compounds with good patent position is critical and will increase the likelihood that a commercial entity will license and develop the product(s). Development of analogs and other chemical modifications requires the intellectual capital of TCCF faculty and a true collaborative effort.

- **Publication**

An agreement must be reached regarding who is able to publish, the specific publications, authorship and other recognition.

- **Use of Resulting Compounds**

For newly created compounds and analogs there must be an understanding with regard to who has the right to transfer the compound(s) to third parties and for what purpose(s). The IP generated through the development of "new compounds" will be part of the original agreement between inventor(s)/ investigator(s) and the TCCF. Only the original inventor(s)/ investigator(s) will have the right to decide which third parties are to be contacted in consultation with the Office of Technology Commercialization. As new compounds or analogs of existing compounds are developed, the Translational Chemistry Core Facility will work with MD Anderson investigators to maximize the patentability of important intellectual property to increase the likelihood of commercial licensing.

OTHER MD ANDERSON CORES

Other MD Anderson Core Resources include:

Biospecimen Extraction Facility

The Biospecimen Extraction Resource provides a centralized laboratory for standardized, high-quality DNA, RNA and protein extraction from blood, tissues, cells, or other patient-derived biospecimen. Additional services include DNA gel electrophoresis, Pico-green DNA quantitation, and whole blood processing for lymphocytes and plasma. Our facility is utilized by both lab-based investigators who want fast turn-around time for standardized and high-quality extractions or whole blood processing and non-lab based investigators (majority are clinicians) who are in great need of the service of sample processing. High quality of DNA/RNA products is the foundation of successful cancer research such as analysis of genetic alterations, gene expression profiling and next generation sequencing. We work very closely with the Sequencing and Microarray Facility (SMF) and the DNA/RNA samples extracted from us can be submitted directly from our core to SMF.

Bone Histomorphometry Core Laboratory

The Bone Histomorphometry Core Laboratory provides histomorphometric analyses of non-decalcified bone specimens, including processing mouse bone specimens for non-decalcified histology and performing static and dynamic histomorphometric analyses of mouse bone specimens. The service is performed on a subsidized fee-for-service basis.

The function of the Bone Histomorphometry core is to perform histomorphometric analyses of non-decalcified bone specimens.

Processing mouse bone specimen for non-decalcified histology. Fixed and partially dehydrated mouse skeleton is provided by project investigators to the Core. These samples are embedded in plastic medium, sectioned and stained. Contact Michael Starbuck, mwstarbu@mdanderson.org, for more information on the protocol for proper sample preparation.

Performing static and dynamic histomorphometric analyses of mouse bone specimen. Using the Osteomeasure analytic system and the Bioquant Osteo II system, static parameters such as bone volume, trabecular number and cell counts as well as dynamic parameters of bone formation such as mineral apposition rates are quantified on non-decalcified bone sections. The core provides investigators with the data and will help them in evaluating their biological relevance.

The lab is affiliated with the Bone Disease Program of Texas for the purpose of providing faculty with high quality bone histomorphometry processing; analysis of the skeleton of genetically modified mice and tumor-bearing bones, and micro-CT analysis of bone specimens.

Cancer Genomics Core Laboratory

The mission of the Cancer Genomics Core Lab is to make genomics technologies accessible to MD Anderson investigators at a reasonable cost.

Technologies

Established in 1999, the Cancer Genomics Core Laboratory has implemented many core technologies: cDNA microarray, SAGE, real-time PCR, SNP assay and tissue microarray.

For microarray technology, we developed and printed a number of focused arrays with either cDNA or long oligonucleotide (70mer) arrays tailored for the different needs of specific cancer research programs. Since 2004, we have switched to the whole genome 44K arrays from Agilent, also based on long oligonucleotide (60mer), which we believe provides better specificity. High-quality results have been obtained with Agilent microarrays in several projects.

Real-time PCR assays based on Applied Biosystems' assay-on-demand are routinely used for validation purposes and for genotyping projects. The tissue microarray facility, which is headed by Dr. Gregory Fuller, chief of neuropathology and immunohistochemistry, provides an important validation of genomics studies at the protein and cell levels.

In 2004, the Cancer Genomics Core Laboratory (Core Lab) implemented the reverse phase protein lysate array technology to profile protein expression. A cell line array that contains 90 different cell lines has been made available to MD Anderson investigators. A new analysis method has been developed and a paper describing the method has been published in the journal *Bioinformatics*. A glioma lysate array project led to a publication highlighted on the cover of the April 2006 issue of *Proteomics*.

Research

The Core Lab personnel closely interact with investigators in RNA quality control, microarray result validation and protein microarrays. Several institutional workshops and minisymposia on microarrays have been organized by the Core Lab for the benefit of investigators. We have provided support to approximately 100 MD Anderson investigators and a number of external collaborators in the areas of microarray, SAGE, SNP, real-time PCR, imaging and data analysis. The Core Lab has assisted numerous MD Anderson investigators in grant applications and has been successful in a number of cases, including the Genitourinary SPORE, R01s and R21.

Keeling Center for Comparative Medicine and Research

The University of Texas MD Anderson Cancer Center established the Veterinary Sciences Division of the Science Park in 1975. The original mission of the center was to provide a wide range of veterinary services and develop specialized animal species to support biomedical research. In accomplishing this mission, the center conducts research aimed at improving the care and management of these resources and research to improve human health.

Located on 381 acres near Bastrop, Texas, it is one of two MD Anderson research facilities in Central Texas. In 2004, the Science Park Veterinary Division was renamed the Michale E. Keeling Center for Comparative Medicine and Research in honor of the late Michale E. Keeling, D.V.M., the first director of the center, and to better reflect the expanding research and educational roles of the center.

The center employs more than 120 staff and faculty, which include veterinarians, animal care staff, basic scientists, research technicians and administrative staff. The facility offers training opportunities for undergraduate, graduate and veterinary medical students from several universities, including The University of Texas MD Anderson Cancer Center, The University of Texas at Austin and Texas A&M University. The Keeling Center currently has federal and private grants and contracts totaling more than \$40,865,000. These extramurally supported programs include research in cancer, hepatitis, HIV, diabetes, hypertension, obesity, vaccine development, cellular immunology, aging and behavior.

The Keeling Center has led the way at MD Anderson by developing a Good Laboratory Practice (GLP) research program that provides an essential part of the institute's translational research program. Research at the Keeling Center has led to the development of synthetic peptide-based candidate vaccines for the prevention and treatment of AIDS caused by HIV and for the treatment of cervical precancerous lesions caused by high-risk human papillomaviruses, and other Keeling Center research has led to techniques to prefabricate molded bone to replace cancerous bone. Pain medications for use in cancer patients have been safety tested at the center, as have other drugs that were subsequently approved for clinical trials. Other studies conducted by faculty at the Keeling Center have contributed to improvements in the health and welfare of laboratory animals. The center's research programs include studies of chemoprevention of ovarian cancer as well as early detection of ovarian and breast cancer. Members of the Keeling Center faculty have strong collaborative relationships with researchers at a variety of institutions in the United States and Europe.

Mission and Vision – Keeling Center

The vision of the Keeling Center is to use the center's unique biomedical research resources to create a center of excellence like no other in the United States. The highly successful programs and expertise with research involving a wide range of animal models create a unique set of research assets to expand and strengthen the center's research and education mission. This places the Keeling Center in a leadership position in research that requires nonhuman primate models of human diseases, especially cancer and cancer-related diseases. The center's GLP program is an essential part of MD Anderson's translational research program. The major activity areas at the Keeling Center include:

- Veterinary services supporting MD Anderson Cancer Center faculty research programs
- Federally supported national biomedical research resources of squirrel monkeys, owl monkeys and chimpanzees
- A breeding resource of rhesus monkeys for pharmaceutical research and testing
- Investigator-initiated grants and contracts in cancer and cancer-related diseases
- Investigator-initiated research projects in primate behavior
- GLP testing in support of MD Anderson's translational research programs
- Post-professional and post-graduate education and training

Mission Statement – Department of Veterinary Sciences

The mission of the Department of Veterinary Sciences of MD Anderson is to eliminate cancer and allied diseases as significant health problems throughout Texas and the nation by developing and maintaining specialized programs in animal models, research and education.

Vision – Department of Veterinary Sciences

The Department of Veterinary Sciences at MD Anderson will be acknowledged as the premier combined veterinary medical/research department within a cancer center. We will attract and nurture outstanding faculty, staff, students and volunteers to carry out our mission.

Animal Care

We will continually set, refine and advance the world's standards for the humane care and management of laboratory animals in cancer and allied disease research. Our standard will be defined by quality of care and research service as well as compassion and respect for the needs of research animals.

Research

We will foster advances in understanding cellular, molecular, genetic and behavioral processes related to cancer, allied diseases and health through science and the development and use of specialized animal models. We will apply these specialized models and the related knowledge to conduct and support translational, preventive and clinical research designed to understand, detect and treat cancer and allied diseases.

Education

We will educate future leaders in veterinary, comparative, laboratory animal, immunological, virological and behavioral sciences to assist in the reduction of the burden of cancer and allied diseases. We will educate students, teachers, community professionals, the public and patients with accurate and helpful information about our research and about the vital role that animal research plays in understanding, preventing, detecting and treating cancer and allied diseases.

Continuous Improvement of Resources

Through a philosophy of continuous improvement, we will effectively manage the animal, human, financial and physical resources; the remote administrative processes and information systems; and the key departmental processes needed to support our mission areas and vision.

Molecular Cytogenetics Facility

The T. C. Hsu Molecular Cytogenetics Core facility offers Conventional as well as Molecular Cytogenetic services including cell line authentication, species identification, karyotyping, analysis of genomic instability, fluorescence in situ hybridization (Figure 1) and Spectral Karyotyping (Figure 2). A key expertise of our facility is to validate the origin of cell lines. Approximately 20-30% of all cell lines used in biomedical research are contaminated (1,2). Many top tier journals have begun to request proof of cell line authentication from investigators. Unlike other methods, chromosomal analysis is able to unambiguously identify cells from all common mammalian species and can also differentiate between cells from the same species. This analysis can therefore identify intra-species and inter-species cell line contaminations.

Multiphoton Microscopy Core

There is an ever-increasing demand to do in vivo imaging, particularly live organ and live animal imaging for biomedical and clinical studies. Multiphoton microscopy provides a glimpse of real-time biology, making it ideal for application in almost all the fields of biomedical research and clinical study.

The Two-Photon Microscopy Core Facility at the Center for Biological Pathways is equipped with a Carl Zeiss multiphoton microscope LSM 7MP. All work is done on a fee-for-service basis to recover costs for equipment maintenance and upkeep. Priority use is given to MD Anderson investigators, but outside users also are accepted.

Services

This core facility provides equipment and expertise to assist investigators in applying advanced multiphoton microscopy techniques to their research.

Multiphoton microscopy imaging: The LSM7MP will be used for advanced 3D image acquisition from live tissue, organ, embryo and animal, as well as time-lapse imaging.

Training: The core will provide training in usage of the multiphoton microscope. Training sessions are arranged in consultation with the facility manager.

Consultation: Consultation on experimental design and approach is provided by the facility manager and director.

Equipment

Zeiss LSM 7MP: LSM 7 MP is a completely dedicated and optimized multiphoton laser scanning microscope system. This system is equipped with a powerful pulsed IR laser, IR laser delivery path, modulation optics, high sensitive non-descanned detectors (NDDs), and the Axio examiner microscope.

Unique Features

- High sensitive GaAsP detectors: 3 times more sensitive than traditional PMTs. This sensitivity increase will allow you to image deeper with less tissue damage than other multiphoton system.
- Ti:Sapphire near infrared laser system: High-quality femtosecond pulsed tunable near infrared laser with pulse energy of up to 3000 mW and repetition rates of 80
- NIR specific scanning system: Highest possible transmission over the range 600 nm to 1300 nm
- High flexibility of optics: The filters and dichroics are housed in 'push and click' filter cubes for quick and easy access and experimental changes
- AxioExaminer Microscope Stand: Specific design for two photon fluorescence and SHG imaging with the implementation of a custom stage
- ZEN software with Smart setup: The Smart setup tool automatically selects optimal settings of the LSM to suit the fluorophores in the sample

Powerful techniques of LSM7MP

- Significant increase of imaging depth into tissue thanks to its NIR wavelength deeper tissue penetration and efficient light detection.
- Less phototoxicity by using NIR excitation photons of energies lower than those of UV or visible wavelengths and by spatially confined fluorescence excitation to a minute sub-femtolitre focal volume
- Tremendous improvement of the optical localization and Z resolution with the smallest z-step of 25nm for 3D imaging
- Dramatically increase of signal-to-noise ratio by the large separation between the incident NIR excitation and the subsequent visible emission wavelengths, as well as eliminating fluorescence except at the focal point of the laser.
- The combination of 2PF and SHG brings to simultaneous imaging of cellular microcomponents and their hosting extracellular collagenous microstructure in bulk tissues, providing valuable information and offering new insights into the complex tissue structures.

Function of LSM7MP

Multiphoton Fluorescence Imaging

1. Focused point excitation
 - Excitation of only fluorophores in the focal center
 - Minimal photo bleaching and photo damage
 - Minimal or no background fluorescence
 - No pinhole before the detector
 - More efficient signal acquisition with NDD
 - No need of UV excitation
2. 3D optical sectioning imaging
 - increase imaging depth to 750um
 - intrinsic high Z resolution
 - interactive volume rendering
3. Multi-point imaging
 - Multiple position imaging over time
 - Live embryo and live tissue imaging over time
4. Second harmonic generated signal (SHG) imaging
 - Forward transmitted SHG imaging for thinner tissue
 - Backward reflected SHG imaging for thicker tissue
 - combination of fluorescence and SHG tomography

Targeted Research Applications

1. Multiphoton microscopy in cancer research: Tumor pathophysiology, gene expression, angiogenesis, cell adhesion and migration, vascular, interstitial and lymphatic transport, metabolic microenvironment and drug delivery in deeper regions of tumor
2. Detection of tumor in transgenic mouse models: Visualization and quantification of tumor stages of neoplastic progression, invasion, angiogenesis and metastasis methods, SHG to facilitate imaging of stromal collagen and tumor-stroma interactions, including the architecture and remodeling of the tumor microenvironment.
3. Multiphoton microscopy in developmental biology: Study embryo development, track cell shape, nuclear position; localization of cytoskeleton molecules during formation of investigated organs in live wild-type and mutant embryos
4. Detection of detailed information on tissue architecture and cellular morphology: Imaging of endogenous fluorescence and SHG eliminate the need to add often-toxic fluorescent labeling normally required to allow biomedical researchers to visualize sub-cellular and

cellular structures in three dimensions and with minimum intervention; in situ even in vivo investigation of tissue microcomponent with high precision and contrast. NAD(P)H autofluorescence of mitochondria can be imaged and the cell morphology is reflected; cells can be identified through the autofluorescent cytoplasm and dark non-fluorescent nuclei and revealing of intact cellular network; the 3D tomography of cellular layers within tissue structure will be investigated.

5. Bioenergetics and metabolism of live specimens in pathophysiology: Only the reduced form of NAD(P)/NAD(P)H are significantly fluorescent. The mitochondrial NAD(P)/NAD(P)H ration can be thereby determined as a function of mitochondrial metabolic states.

Sequencing and Non-Coding RNA Program

The Sequencing and Non-coding RNA Program, a service of the Center for Targeted Therapy, offers MD Anderson investigators cutting-edge, emerging technology and expertise in functional genomics for the discovery of new non-coding RNAs (ncRNA) and expression profiling for known ncRNAs to further their cancer research.

Primary Services

- **SOLiD™ System**

A “next generation” genome sequencing technology platform that provides broad applications for various forms of genome sequencing; gene expression, epigenetic and transcriptome profiling; and small RNA discovery. Applications include: whole genome sequencing; targeted genome re-sequencing; whole transcriptome, small RNA and mRNA expression sequencing and profiling; de novo sequencing; ChIP-sequencing; and epigenetic methylation sequencing and profiling. No other institution, at this time, is utilizing this technology as a service for its scientists.

- **ncRNA/miRNA Expression Array Profiling**

Conducted on in-house microarray platforms and has the capacity to profile up to approximately 48 samples per week. The program’s director, [Dr. Chang-gong Liu](#), developed the first-ever ncRNA/miRNA microarray platform.

- Full-service support for all **Affymetrix GeneChip®** microarray technology including genome-wide mRNA expression profiling, SNP genotyping and ChIP-on-Chip, to name but a few. Turnaround time is approximately three-to-five days.
- Support gene expression quantitation and the detection of SNPs utilizing the **Applied Biosystems Fast Real-Time PCR System** with a turnaround time of approximately two-to-three hours.
- Within one hour, the program can provide quantification and analysis of DNA, RNA, proteins and cells with the **Agilent 2100 Bioanalyzer** and the **Thermo Scientific NanoDrop™ 1000 Spectrophotometer**.

About Non-Coding RNAs

The study of non-coding RNAs (ncRNAs), and specifically microRNAs (miRNAs), represents one of the most active research areas in molecular biology and continues to shed light on the human genome. Non-coding RNAs are molecules that are not translated into proteins and they play an important role in cancer initiation, progression and metastases. Already miRNAs have shown promise as diagnostic and prognostic markers in cancer and as targets for the development of new therapeutic approaches. The CTT brings MD Anderson to the forefront of this emerging

field of cancer research by introducing its newest offering – the ncRNA Program.

Non-coding RNAs (ncRNAs) are a new class of RNA transcribed from 80% of the human genome and can be classified based on sizes as small as ~18 to 40 nucleotides (nts) that includes miRNA, siRNA, piwiRNA, rasiRNA and large ncRNA sized more than 50 nts. They are transcribed from intergenic, intronic, antisense and interleaved regions and overlap with protein-coding genes.

Predictions suggest that miRNAs regulate approximately 30% of protein-coding genes in the human genome that relate to development, differentiation, proliferation, apoptosis, house-keeping, metabolism and signaling pathways (Lewis et al., 2005). The ncRNA Program at MD Anderson offers two technologies for research of ncRNAs: microarrays and SOLiD™ next generation sequencing.

1. Microarrays were developed as a powerful high throughput technology to monitor thousands of mRNA or ncRNA by transcriptional profiling in a single experiment. In order to gain more insight into the biological functions specifically related to miRNAs globally and understand the involvement of miRNAs in human cancer, we developed a high throughput custom miRNA array platform that profiled and analyzed more than 10,000 primary tumors or cell lines (Liu et al., 2008). We found that miRNA expression signatures are a powerful tool to classify tumors or sub-classify every type of human cancer (Volinia et al., 2006; Iorio et al., 2007). The miRNA profiling data from cancers that has been collected suggests that mis-regulations of miRNA expression are key components in biological processes – including the pathways leading to cancers.
2. Small RNA-seq and whole transcriptome-seq by SOLiD™ next generation sequencing enables us to sequence not only all known expressed, small and large non-coding RNA and protein-coding mRNA globally in one single experiment for signatures, but it is also a powerful approach for non-coding biomarker discovery in cancers.

Proteomics Facility

The Proteomics Facility at The University of Texas MD Anderson Cancer Center was founded in 2002.

The facility provides state-of-the-art mass spectrometry analysis of proteins for both basic and clinical cancer research. We work with internal as well as external researchers.

Our Mission

The primary mission of the Proteomics Facility is to serve the faculty of the MD Anderson Cancer Center by providing access to mass-spectrometry based proteomics technology and services.

What is the Proteome?

The term proteome was coined in the mid-1990s to describe the set of proteins encoded by the genome.

-ome: Transcriptome, interactome, degradome, metabolome, secretome, etc.

What is Proteomics?

Proteomics is the study of proteomes or the systematic analysis of proteins.

It is pronounced as [pro•te•o•mics] (prOt-E-'O-miks) but not [proteonomics].

As defined by Merriam-Webster dictionary: a branch of biotechnology concerned with applying the techniques of molecular biology, biochemistry and genetics to analyzing the structure, function and interactions of the proteins produced by the genes of a particular cell, tissue or organism, with organizing the information in databases, and with applications of the data (as in medicine or biology).

Proteomics was originally used for the large scale identification of proteins separated by 2D gel electrophoresis. However, proteomics now includes not only the analysis of all expressed protein analysis but also traditional protein structural studies such as protein identification, post-translational modification, protein-protein interactions and other functional interests related with protein structure.

Protocol Review and Monitoring

The primary goal of the Protocol Review and Monitoring System (PRMS) is to ensure that all human-subjects research is of the highest scientific quality possible. The functions of the PRMS are supported by the staff and management in the Office of Protocol Research (OPR), which resides within the Office of the Vice President, Clinical Research (OCR).

Center for RNA Interference and Non-Coding RNAs

The highly efficient delivery of short-interfering RNA (siRNA, shown in red) is illustrated in this image. The siRNA was packaged in neutral nanoliposomes which were intravenously injected into mouse models. The target: ovarian cancer cells (blue).

The Center for RNA Interference and Non-Coding RNAs (RNA Center), established under the Red and Charline McCombs Institute for the Early Detection and Treatment of Cancer, is a unique collaborative initiative among MD Anderson Cancer Center, Baylor College of Medicine, the University of Texas Health Science Center at Houston, Rice University and the University of Houston that will focus on gaining insights into the roles of newly discovered RNAs in cancer initiation, progression and dissemination.

Mission

To identify, engineer and accelerate breakthroughs in non-coding RNA (ncRNA) discoveries leading to cancer biomarkers and therapeutics.

Objective

Short-term

Building on existing clinical research at MD Anderson Cancer Center through collaborations and membership to the RNA Center to create a ncRNA-centric effort to drive discovery of molecular markers of cancer by evaluating, co-developing, facilitating and disseminating novel ncRNA technologies.

Long-term

Creating an institution-wide ncRNA resource to collaborate and lend expertise in the ncRNA and RNAi areas of clinical and basic research.

Overview

With promise in broad areas ranging from relief of cancer-related chronic pain to management of deadly brain metastasis, RNAi has potential applications for every type of cancer. RNAi offers a powerful and highly specific method for shutting off genes that promote cancer growth. Our researchers aim to develop this potential across the full continuum of cancer care.

MicroRNA and other short or long non-coding RNAs alterations are involved in the initiation, progression and metastases of human cancer. The main molecular alterations are represented by variations in gene expression, usually mild and with consequences for a vast number of target protein coding genes. The causes of the widespread differential expression of non-coding RNAs in malignant compared with normal cells can be explained by the location of these genes in cancer-associated genomic regions, by epigenetic mechanisms and by alterations in the processing machinery.

Expression profiling of microRNA and other short or long non-coding RNAs in human tumors has identified signatures associated with diagnosis, staging, progression, prognosis and response to treatment. In addition, profiling has been exploited to identify non-coding RNAs that may represent downstream targets of activated oncogenic pathways or that are targeting protein coding genes involved in cancer. Recent studies proved that miRNAs and non-coding ultraconserved genes are main candidates for the elusive class of cancer predisposing genes and that other types of non-coding RNAs participate in the genetic puzzle giving rise to the malignant phenotype. These discoveries could be exploited for the development of useful markers for diagnosis and prognosis, as well as for the development of new RNA-based cancer therapies.

Science Park Shared Resources, Cores and Services

The Department of Molecular Carcinogenesis at Science Park has a number of shared resources and cores that provide services to members of the department, researchers from other MD Anderson Cancer Center departments in Bastrop and Houston, as well as other Central Texas institutions such as the University of Texas at Austin. These core facilities are used extensively and have proven vital for advancing the department's research mission, allowing faculty to publish in high-impact journals and to generate key preliminary data to help secure grant funding.

Molecular Biology and Protein Analysis

- Molecular Biology Core
- Next-Generation Sequencing Core
- Protein & Metabolite Analysis Facility
- DNA Methylation Analysis Core

Cell and Tissue Analysis

- Flow Cytometry Core
- Confocal Microscopy Core

Histology and Pathology

- Histology & Tissue Processing Core

Research Animal Facilities & Services

- Research Animal Support Facility
- Transgenic Animal Core
- Laboratory Animal Genetic Services
- Mutant Mouse Pathology Service

Bioinformatics and Biostatistics

- Bioinformatics
- Biostatistics

siRNA Screening Facility

All investigators interested in performing a High Throughput or a High content siRNA screen will be invited to a preliminary meeting with the staff of the screening service. During this meeting all essential details regarding the screen will be discussed including cell lines, assay design, standard operating procedure of a screen, time line, cost and cell culture models. We currently have the capability of performing high throughput screens in utilizing both 2D monolayer cell culture models and 3D spheroid cell culture models.

TEXAS MEDICAL CENTER

Texas Medical Center

Texas Medical Center (TMC) is a comprehensive medical complex that was organized in the mid-1940s as a means for coordinating medical and health education, patient care, and related research in a not-for-profit setting. Today it stands as the leading health care destination for people all over the world. More than 160 permanent buildings, not including Rice University, occupy nearly 1,000 acres that include 15 patient care facilities and 21 academic and research institutions, housing 20,000 advanced-degreed professionals in the life sciences. There are approximately 12,000 volunteers who assist with a wide variety of tasks benefiting the TMC.

More than 106,000 full and part-time employees work in the Texas Medical Center in member institutions with a combined annual operating budget in excess of \$6 billion. TMC hospitals contain more than 7,000 licensed beds with more than 7.2 million visits recorded per year. .

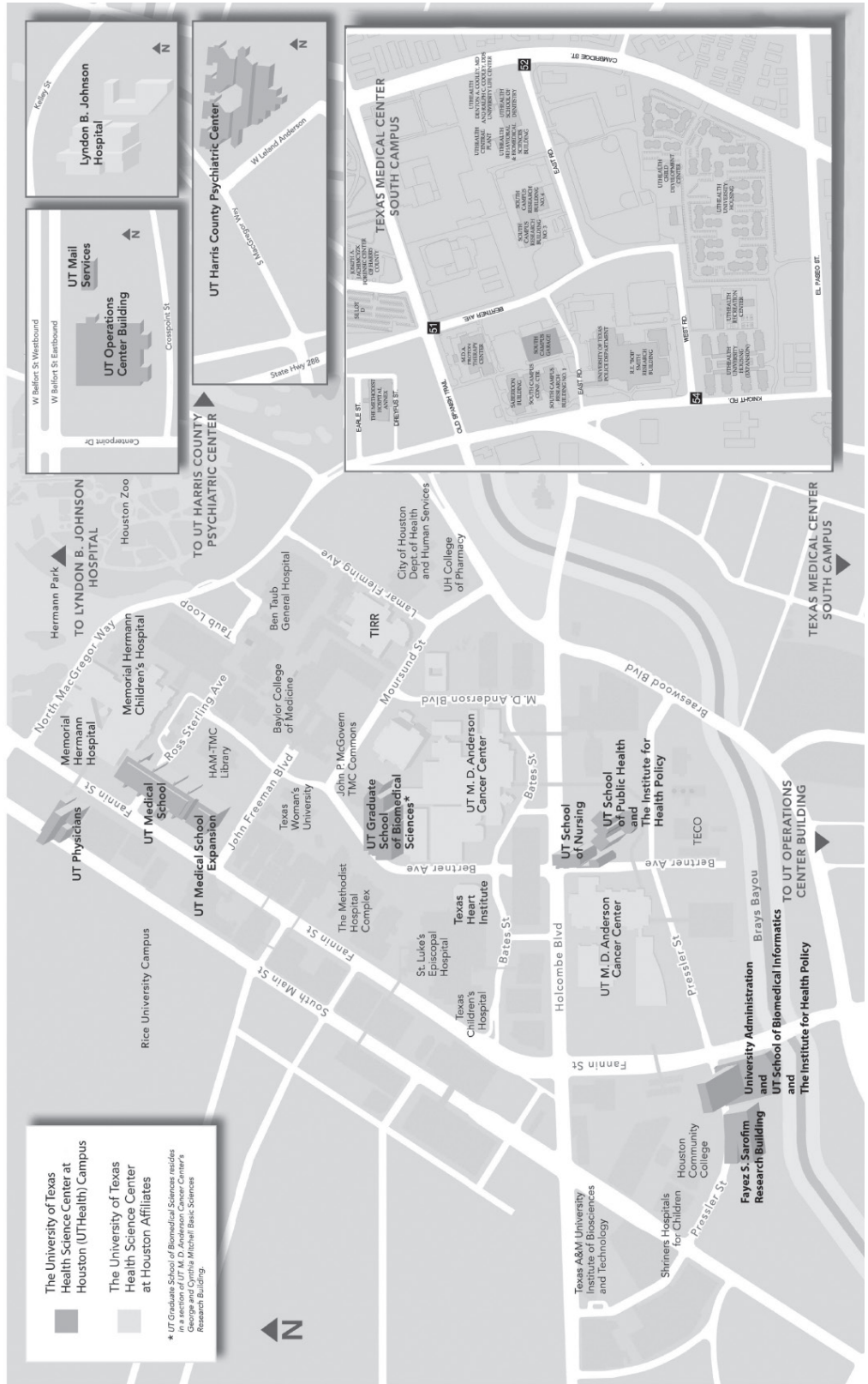
With nearly 72,000 students, the Texas Medical Center includes three medical schools, six nursing schools, a dental school, two colleges of pharmacy, a school of public health, a high school for the health professions (with an annual rate of greater than 95 percent of its graduates going on to college), a community college specializing in health careers training, plus other graduate and post-graduate schools and programs to provide training in the allied health professions.

The Houston Academy of Medicine-Texas Medical Center (HAM-TMC) Library, which serves as the accredited library for most of the TMC institutions, is recognized as one of the largest academic health sciences libraries in the U.S. In addition, research expenditures of the Texas Medical Center member institutions total about \$1.8 billion annually.

One of the most distinctive and visited locations in the Texas Medical Center is The John P. McGovern Texas Medical Center Commons amenities building, which is the central meeting and gathering place for thousands of staff, patients and visitors who frequent the campus daily. It features an exterior 64-foot waterwall; Waterside Court, which provides eight diverse food concepts; Trevisio Restaurant for fine dining, meetings and special events; and a 500-space parking garage. The Graduate School of Biomedical Sciences is located next door to the Commons.

A major part of this “biomedical city” called the Texas Medical Center is UHealth, the most diverse of the academic health institutions in the Texas Medical Center.

UNIVERSITY CAMPUS MAP
IN THE TEXAS MEDICAL CENTER



MEMORIAL HERMANN HOSPITAL-TEXAS MEDICAL CENTER, CHILDREN'S MEMORIAL HERMANN HOSPITAL AND TIRR MH

The Memorial Hermann-Texas Medical Center Campus is home to three hospitals: Memorial Hermann–Texas Medical Center, Children’s Memorial Hermann Hospital and TIRR Memorial Hermann.

Part of the 12-hospital Memorial Hermann System, these hospitals serve as primary teaching hospitals for The University of Texas Medical School at Houston, ensuring that patient care is based on new knowledge at the frontiers of medicine.

Memorial Hermann-Texas Medical Center

For generations, Houston and its surrounding communities have trusted Memorial Hermann-TMC for outstanding care. Memorial Hermann-TMC built a reputation for excellence in heart and vascular, cancer, neuroscience, sports medicine and orthopedics, specialty surgery and organ transplantation.

As the first hospital to open its doors in the renowned Texas Medical Center, Memorial Hermann-TMC has a long history of innovation. These are just a few of the firsts: In 1946, Memorial Hermann-TMC was the first in Texas to perform a cardiac catheterization. In 1976, the hospital was the first in Texas and the second in the nation to launch an air ambulance program, Memorial Hermann Life Flight®, which remains Houston’s only hospital-based air ambulance service. In 1985, Memorial Hermann-TMC broke new ground in the treatment of end-stage liver disease as the site of Houston’s first liver transplant. In 1988, the hospital opened the first stroke center in Houston and one of the first dedicated stroke programs in the world. In 2005, Memorial Hermann-TMC was the first in the world to perform robotic reconstructive aortic surgery. In 2006, Memorial Hermann-TMC performed the first four-organ transplant in Houston and only the fourth in the nation. In 2011, Memorial Hermann-TMC gained world wide recognition for the treatment of Congresswoman Gabrielle Giffords where UTHealth faculty led the treatment team.

Through revolutionary advances in medicine and surgery, Memorial Hermann-TMC set new standards of care for the nation and has been recognized as an industry leader by prestigious national organizations, including Thomson Healthcare, VHA, U.S. News & World Report, University Health System Consortium and the American Heart Association.

Children’s Memorial Hermann Hospital

When families come to Children’s Memorial Hermann Hospital, they expect to find the technological advances and healing expertise of a university-affiliated academic hospital. What continues to surprise them is the special compassion and focus on families that distinguishes Children’s Memorial Hermann Hospital as one of the finest in the nation.

Founded in 1986, Children’s Memorial Hermann Hospital is the primary teaching institution for the pediatrics and obstetrics/gynecology programs at The University of Texas Medical School at Houston. Our healthcare professionals are focused on the specialized needs of women and children, with an emphasis on quality, customer service and leading-edge research.

The hospital offers the latest advances in maternal-fetal medicine and neonatal critical care services, as well as renowned programs in pediatric trauma, neuroscience, pulmonology and cardiac services. Interdisciplinary teams include experienced nurses, child life specialists, pediatric respiratory therapists, pediatric clinical pharmacists, social workers and more. In 2012, Children’s Memorial Hermann Hospital became the first in Texas to perform in-utero surgery in the treatment of Spina Bifida.

As part of Memorial Hermann’s network of hospitals, patients can now access children’s healthcare or high-risk pregnancy services at our affiliated hospitals in the community or, for more acute healthcare needs, at Children’s Memorial Hermann’s main facility in the Texas Medical Center.

TIRR Memorial Hermann

TIRR Memorial Hermann changes lives by improving outcomes, offering hope and maximizing independence for people affected by disabling injury or illness. Recognized among the leading rehabilitation hospitals in the country, TIRR serves as a model for interdisciplinary rehabilitation services, patient care, education and research.

TIRR is one of only six rehabilitation hospitals in the nation designated as model systems by the National Institute on Disability and Rehabilitation Research (NIDRR) for both our spinal cord injury and traumatic brain injury programs. For 21 consecutive years, U.S. News & World Report has named TIRR to the list of “America’s Best Hospitals.”

TIRR’s reputation is based on more than 50 years of experience in rehabilitation and research, the high caliber of physician partners and clinical staff and comprehensive programs and services. TIRR is also recognized for its long-standing commitment to educating patients, families, healthcare professionals, caregivers and the general public about rehabilitation. Extending TIRR knowledge and resources into the community remains a top priority and part of its pledge to make a difference in the lives of those recovering from disabling injury and illness.

Website of Memorial Hermann locations:

<http://www.memorialhermann.org/locations/default.html>

The University of Texas MD Anderson Cancer Center

Celebrating seven decades of Making Cancer History®, The University of Texas MD Anderson Cancer Center ranks as one of the world’s most respected and productive centers devoted exclusively to cancer patient care, research, education and prevention. It is one of the nation’s original three comprehensive cancer centers designated by the National Cancer Act of 1971.

Since 1944, patients have turned to MD Anderson for cancer care in the form of targeted therapies, surgery, chemotherapy, radiation and proton therapy, immunotherapy, or combinations of these and other treatments. This multidisciplinary approach to treating cancer was pioneered at MD Anderson. This brings together teams of experts across disciplines to collaborate on the best treatment plan for patients. MD Anderson’s experts focus solely on cancer, and they are renowned for treating all types of cancer, including rare or uncommon diseases.

In Fiscal Year 2012, MD Anderson provided cancer care for about 115,000 patients. Of those, nearly one-third were new patients. About one-third of patients come to Houston from outside Texas, seeking the knowledge-based care that has made MD Anderson so widely respected. There were about 8,500 registrants on clinical trials exploring novel therapies and diagnostic tests in FY12, making it the largest such program in the nation.

At MD Anderson, important scientific knowledge gained in the laboratory is rapidly translated into clinical care. Overall, MD Anderson's research program is considered one of the most productive efforts in the world aimed solely at cancer.

In FY12, MD Anderson invested more than \$647 million in research, an increase of 33% in the past five years. The institution ranks first in the number of research grants awarded and total amount of grant funds given by the National Cancer Institute and holds 12 NCI Specialized Programs of Research Excellence (SPORE) grants.

A new **Moon Shots Program** has launched to dramatically accelerate the pace of converting scientific discoveries into clinical advances that reduce cancer deaths. The program brings together multidisciplinary groups of researchers and clinicians to mount comprehensive attacks on eight cancers initially. They'll work as part of six moon shot teams: acute myeloid leukemia and myelodysplastic syndrome, chronic lymphocytic leukemia, melanoma, lung cancer, prostate cancer, and triple-negative breast and high-grade serous ovarian cancers, which are linked at the molecular level. In FY12, almost 7,500 trainees, including physicians, scientists, nurses and allied health professionals, took part in MD Anderson educational programs. More than 300 students attended the institution's School of Health Professions, which offers bachelor's degrees in eight allied health disciplines. The school is launching a master of science in diagnostic genetics program in 2013.

More than 1,000 clinical residents and fellows come to MD Anderson each year to receive specialized training in the investigation and treatment of cancer. More than 550 graduate students are working on advanced degrees at the Graduate School of Biomedical Sciences, which MD Anderson operates with The University of Texas Health Science Center at Houston. The institution's laboratories provide training for 1,700-plus research fellows.

MD Anderson employs more than 19,000 people, including more than 1,600 faculty. A volunteer corps of about 1,248 people contributed more than 192,152 hours of service in FY12, equal to 92 full-time employees. All are dedicated to MD Anderson's core values of caring, integrity, and discovery. Together they work toward fulfilling MD Anderson's mission of eliminating cancer as a major health threat.

Support activities, such as UT Police, are joint activities of MD Anderson and UTHealth.

Website: <http://www.mdanderson.org/>

Houston Academy of Medicine-Texas Medical Center Library



The Houston Academy of Medicine-Texas Medical Center (HAM-TMC) Library serves as the accredited library for most Texas Medical Center institutions and is the primary library for The University of Texas Medical School at Houston. The Library is also home to the **John P. McGovern Historical Research Collection**, as well as the Menninger Collection on Psychiatry and Psychoanalysis, one of the world's most comprehensive collections of books, journals and archival materials in psychiatry, psychoanalysis and psychology.

Currently, the HAM-TMC Library contains 76,500 square feet of space and holds over 357,023 volumes, including books and journal volumes. Additionally, the Library has subscriptions to over 200 electronic databases and over 8,000 electronic journals. Over 50 public access computers are available to library users for Internet access and research, as well as word processing, database development and preparation of spreadsheets and public presentations through Microsoft® software applications. WiFi is available throughout the Library. The Library also offers such classes as Navigating, in addition to instruction in RefWorks, Tracking Your Publications and Creating Your Own eBooks.

Since 1991, the Library has served as the Regional Medical Library for the National Network of Libraries of Medicine, South Central Region, with responsibility for the library needs of health professionals in the five-state region of Arkansas, Louisiana, New Mexico, Oklahoma and Texas. Chosen by the National Library of Medicine, there are only eight Regional Medical Libraries in the nation.

Website: <http://www.library.tmc.edu/>

Research Medical Library of MD Anderson



The Research Medical Library provides information resources and specialized services to MD Anderson faculty, staff, and all GSBS students to further the institution's programs in patient care, research, education, and prevention. The main Library is located on the 21st floor of the Pickens Academic Tower with satellite locations on South Campus (SCRB4) and in Smithville and Bastrop.

The Library is also home to the Historical Resources Center (HRC), which was established in 2000 as the official archival repository for institutional records, personal papers, photographs, videos, oral history interviews, and other materials that document MD Anderson's role in advancing cancer medicine, science, and public policy. It also encompasses the History of Cancer Collection of rare books, journals, monographs, and other published material.

The Library offers more than 100,000 print and electronic books; 5,500 electronic journals; 150 online databases; free interlibrary loans and expert searching; classes on PubMed, Scopus, and EndNote; and an embedded librarian in the School of Health Professions.

Facilities – Pickens Academic Tower

- Occupies entire 21st floor of the T. Boone Pickens Academic Tower: 18,173 square feet
- Collaborative classroom with 18 laptops
- Videoconference/seminar room with capacity for 24 conference/42 theater style
- Three group study rooms with computer and whiteboard
- 46 public computers
- 166 total seating capacity

Facilities – SCRB4

- Located on the 1st floor of the South Campus Research Building 4: 5,170 square feet
- Two meeting rooms equipped with collaborative MediaScape Table technology
- One “demo room” for small group hands-on instruction
- Six public computers
- Six laptops available for in-building checkout
- Book pick-up and drop-off services

Smithville

- Located on the campus of Science Park in Smithville, the Library has four networked study carrels including three Macs and one PC
- Two reading areas with journal and textbook collections
- A meeting/reading room with white board and seating for six
- Library liaison service provided by the Outreach Coordinator based in Houston

Bastrop

- Located on the campus of the Michale E. Keeling Center for Comparative Medicine and Research in Bastrop, the Library has seating for 8 including video and teleconferencing capabilities
- Journal and textbook collections
- Library liaison service provided by the Outreach Coordinator based in Houston

<http://www3.mdanderson.org/library/>

ACADEMIC GENERAL INFORMATION

Degrees Offered at The University of Texas Health Science Center at Houston

School/Program	Degree	Cert.	Bach.	Mast.	Doc.
School of Dentistry	D.D.S.				X
	Oral and Maxillofacial Surgery Certificate (4 years post-DDS)	X			
	Oral and Maxillofacial Surgery Certificate/MD* (6 years post-D.D.S.) *MD degree conveyed by UT Medical School	X			X
	Advanced Education Programs General Practice Residency (GPR) Advanced Education in General Dentistry (AEGD) (certificate only):	X			
	M.S.D* . Endodontics, Periodontics, Prosthodontics (*M.S.D. is required in these programs in addition to the certificate); Orthodontics, Pediatric Dentistry (certificate program, M.S.D. is optional)	X		X	
	B.S. in Dental Hygiene		X		
	Dental Hygiene Certificate Program	X			
Graduate School of Biomedical Sciences	M.S. in Biomedical Sciences (with concentrations in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Biomedical Sciences; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Experimental Therapeutics; Genes and Development; Genetic Counseling; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Molecular Carcinogenesis; , Neuroscience; Virology and Gene Therapy).			X	

School/Program	Degree	Cert.	Bach.	Mast.	Doc.
Graduate School of Biomedical Sciences	Ph.D. in Biomedical Sciences (with concentrations in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Experimental Therapeutics; Genes and Development; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Molecular Carcinogenesis; Neuroscience; Virology and Gene Therapy).				X
School of Biomedical Informatics	Certificate (in Health Informatics)	X			
	M.S. (in Health Informatics) (Focus areas in Biomedical Engineering, Clinical Informatics, Computational Biomedicine, Learning and Technology and Public Health Informatics)			X	
	Ph.D. (in Health Informatics) (Focus areas in Biomedical Engineering, Clinical Informatics, Computational Biomedicine, Learning and Technology and Public Health Informatics)				X
Medical School	M.D.				X
	M.S. in Clinical Research			X	
School of Nursing	B.S.N.		X		
	M.S.N.			X	
	Ph.D. (in Nursing)				X
	D.N.P.				X
School of Public Health	M.P.H. (in Public Health)			X	
	M.S. (in Public Health)			X	
	Dr.P.H. (in Public Health)				X
	Ph.D. (in Public Health)				X
	Certificate in Public Health	X			
	Certificate in Public Health Informatics	X			

Accreditation at UTHealth

The University of Texas Health Science Center at Houston is accredited by the Southern Association of Colleges and Schools Commission on Colleges to award certificate, baccalaureate, masters, doctorate and professional degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of The University of Texas Health Science Center at Houston.

While SACS accredits the total institution, many of the academic degree programs offered at UTHealth also undergo accreditation by specialized accrediting bodies*. They are as follows:

School	Degree or Certificate	Accrediting agency
School of Dentistry	D.D.S.	American Dental Association Commission on Dental Accreditation
	M.S.	American Dental Association Commission on Dental Accreditation
	Advanced Education Certificate Program	American Dental Association Commission on Dental Accreditation
	B.S. (Dental Hygiene)	American Dental Association Commission on Dental Accreditation
	Dental Hygiene Certificate Program	American Dental Association Commission on Dental Accreditation
	Oral and Maxillofacial Surgery Certificate Program	American Dental Association Commission on Dental Accreditation
Graduate School of Biomedical Sciences	M.S. with specialization in Genetic Counseling	American Board of Genetic Counseling
	M.S. with specialization in Medical Physics	Commission on Accreditation of Medical Physics Education Programs
	M.S.	
	Ph.D.	
Medical School	M.D.	American Medical Association/ Association of American Medical Colleges Liaison Committee on Medical Education (LCME)
		Accreditation Council for Graduate Medical Education (ACGME)
		Accreditation Council for Continuing Medical Education (ACCME)
	M.S. in Clinical Research	

School	Degree or Certificate	Accrediting agency
School of Biomedical Informatics	M.S.	
	Ph.D.	
School of Nursing	B.S.N.	Commission on Collegiate Nursing Education
	M.S.N.	Commission on Collegiate Nursing Education
	Nurse Anesthesia	Council on Accreditation of Nurse Anesthesia Educational Programs
	D.N.P.	Commission on Collegiate Nursing Education
	Ph.D. (Nursing)	
School of Public Health	M.P.H.†	Council on Education for Public Health
	M.S.†	Council on Education for Public Health
	Dr.P.H.	Council on Education for Public Health
	Ph.D.	Council on Education for Public Health
	M.P.H. (Industrial Hygiene)	The Applied Science Accreditation Commission of the Accreditation Board for Engineering and Technology

* The University of Texas Health Science Center at Houston is also accredited by the Accreditation Council for Continuing Medical Education (ACCME) to sponsor continuing medical education for physicians.

† The Industrial Hygiene Curriculum in the MPH and MS degree programs is accredited by the Applied Science Accreditation Commission (ASAC) of Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.

Degrees Offered at The University of Texas MD Anderson Cancer Center

School/Program	Degree or Certificate	Cert.	Bach.	Mast.	Doc.
School of Biomedical Sciences	M.S. in Biomedical Sciences (with concentration in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Biomedical Sciences; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Experimental Therapeutics; Genes and Development; Genetic Counseling; Human and Molecular Genetics; Immunology; Medical Physics; Microbiology and Molecular Genetics; Molecular Carcinogenesis; Neuroscience; Virology)			X	
	Ph.D. in Biomedical Sciences (with concentration in Biochemistry and Molecular Biology; Biostatistics, Bioinformatics and Systems Biology; Cancer Biology; Cell and Regulatory Biology; Clinical and Translational Sciences; Experimental Therapeutics, Genes and Development, Human and Molecular Genetics, Immunology, Medical Physics, Microbiology and Molecular Genetics, Molecular Carcinogenesis, Neuroscience, Virology)				X
School of Health Professions	Clinical Laboratory Science	X	X		
	Cytogenetic Technology	X	X		
	Cytotechnology	X	X		
	Diagnostic Imaging		X		
	Histotechnology	X			
	Medical Dosimetry	X	X		
	Molecular Genetic Technology		X		
	Radiation Therapy	X	X		

Accreditation at MD Anderson

The University of Texas MD Anderson Cancer Center is accredited by the Southern Association of Colleges and Schools Commission on Colleges to award baccalaureate, masters, and doctoral levels. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4501 for questions about the accreditation of The University of Texas MD Anderson Cancer Center.

Many of the academic degree programs offered at MDACC undergo accreditation by specialized accrediting bodies.* They are as follows:

School/Program	Degree	Accrediting Agency
The University of Texas MD Anderson Cancer Center School of Health Professions		
Cytogenetic Technology	B.S.	National Accrediting Agency for Clinical Laboratory Sciences
Clinical Laboratory Science	B.S.	National Accrediting Agency for Clinical Laboratory Sciences
Diagnostic Imaging	B.S.	Joint Review Committee on Education In Radiologic Technology
Diagnostic Genetics	M.S.	National Accrediting Agency for Clinical Laboratory Sciences
Histotechnology	B.S.	National Accrediting Agency for Clinical Laboratory Sciences
Cytotechnology	B.S.	Commission on Accreditation of Allied Health Education Programs
Medical Dosimetry	B.S.	Joint Review Committee on education in Radiologic technology
Molecular Genetic Technology	B.S.	National Accrediting Agency for Clinical Laboratory Sciences
Radiation Therapy	B.S.	Joint Review Committee on Education in Radiologic Technology
The University of Texas Graduate School of Biomedical Sciences at Houston		
	M.S. with specialization in Genetic Counseling	American Board of Medical Genetics
	M.S. and Ph.D. with specialization in Medical Physics	American Association of Physicists in Medicine

*The University of Texas MD Anderson Cancer Center is also accredited by the Accreditation Council for Continuing Medical Education (ACCME) and the Accreditation Council for Graduate Medical Education (ACGME).

UTHealth Academic Qualifications

In accordance with Department of Education guidelines, in order to receive Title IV financial aid funds, a student must be qualified to study at the postsecondary level. A student qualifies if he/she:

- Has a high school diploma;
- Has the recognized equivalent of a high school diploma, typically a general education development (GED) certificate;
- Has completed home schooling at the secondary level; or
- Has an academic transcript of a student who has successfully completed at least a two-year program that is acceptable for full credit toward a bachelor's degree.

In addition to these qualifications, please refer to the school catalog section for specific admissions criteria for academic degree program in each of the UTHealth schools.

Academic Fresh Start

If a student who enrolls under the Texas Fresh Start program, completes a prescribed course of study, earns a baccalaureate degree, and applies for admission to a postgraduate or professional program, the institution, in considering the applicant for admission into the postgraduate or professional program, shall consider only the grade point average of the applicant established by the course work completed after enrollment under the Texas Fresh Start program, along with any other criteria the institution uses in evaluation applications for admission.

Academic Common Market

The Academic Common Market (ACM) is an interstate agreement among southern states for sharing academic uncommon programs. Participating states arrange for their residents who qualify for admission to enroll in specific programs in other states on the in-state tuition basis. The ACM is available only to states that are members of the Southern Regional Educational Boards.

Tuition and Fees

Tuition and fees are subject to change by legislative or Regental action and become effective on the date enacted. The Texas Legislature does not set the specific amount for any particular student fee. The student fees assessed are authorized by state statute; however, 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. Please refer to the Office of Registrar website at <https://www.uth.edu/registrar/current-students/registration/tuition--fee-schedule.htm> for current Tuition and Fee Schedules.

For additional tuition and fee information go to the Office of the Registrar's website under Current Students/Student Information for a list of general information helpful to all students. The website discloses current information regarding tuition and fee exceptions and/or waivers, Veterans' education benefits, and the Policy for Texas Resident Tuition. Please refer to the Office of the Registrar website at <http://www.uth.edu/registrar/> to view this information.

Tuition and Fees Payment Policy

Payment of tuition and fees are due no later than the last day of regular registration for the term.

Students whose registration is cancelled because of non-payment by issuing an insufficient funds check will not be reinstated for the term.

An insufficient check fee of \$25.00 will be assessed for each returned check.

Students who have fees billed to a sponsor are financially responsible for any charges determined to be uncollectible by the Accounting Office. Furthermore, extended delays in collection of receivables from sponsors will require the student to make the uncollected payment. Student payments will be refunded upon receipt of payment from the sponsor.

Payment of tuition and fees may be paid in full or in installments for the fall, spring and summer 12 week semester. An Installment Use Fee of \$20 will be assessed for the use of the installment plan. A \$25 Late Payment Fee will be assessed if the initial payment is late; a \$25 charge will be assessed for each subsequent delinquent installment payment. Certain fees, such as health insurance, liability insurance and the installment use fee are not installable and must be paid in full at the initial payment. Check with the Bursar's Office for a complete list of non-installable fees.

A student who fails to provide full payment of tuition and fees, including late fees assessed by the university, when the payments are due, is subject to one or more of the following actions:

- Prohibited from registration in future terms until full payment is made,
- Withholding of degree and/or official transcript,
- May be denied credit for the work done during the academic year, and
- Subject to all penalties and action authorized by law.

For more information regarding tuition and fee payment, installment plans and payment methods please contact:

Bursar's Office
The University of Texas Health Science Center at Houston
University Center Tower
7000 Fannin, Suite 2240
713-500-3380

Bursar Website: <https://inside.uthouston.edu/finance/bursars/>

Adding, Dropping and Withdrawing Courses

For all programs other than Medical School (MD) and Dentistry (DDS) students may add and drop classes after initial enrollment period during the first twelve days of the fall and spring semesters and during the first four days of the summer term. Students withdrawing from classes after the initial drop/add period must submit a drop form that may be obtained from the Student Affairs Office in each school or from the Office of the Registrar.

Classes dropped on or before the 12th class day of a semester or 4th class day of a summer term will not appear on a student's transcript. Classes dropped after the 12th class day of a semester or the 4th class day of a summer term will appear on the student's permanent record with a "W", "WP" or "WF" grade, depending upon the school's grading policy.

Students should check with their school advisor or instructor to make sure the appropriate specific program approvals, guidelines and deadlines for add, drop or withdrawals from courses are followed.

Refunds for classes dropped will be credited in strict accordance to the schedule specified by state law and will depend on the number of days that have elapsed since the beginning of the semester or term. Please see Refund Policy section for additional information.

Class Schedule Contents with add/drop and information can be found on MyUTH class search.

Refund Policy

All programs at UTHealth follow a standard Refund Policy based on the first day of the semester term and not on the first day class convenes. Refunds shall be made of applicable tuition and fees collected for courses from which a student drops within the first twelve days of the fall and spring semesters, provided the student remains enrolled at the institution. Refunds made of applicable tuition and fees collected for courses which a student drops, shall be made as soon as practicable during the two summer semesters, provided the student remains enrolled at the institution, will be as follows: 1) within the first four days of the 6 week summer session; and 2) within the first 12 days of the 12 week summer session.

All refunds will be based on the day the student drops the course(s) electronically through MyUTH (<https://www.uth.edu/registrar/myuth.htm>) or the date the official withdrawal form is received in the Registrar's Office.

Refunds of tuition and mandatory fees shall be made to the students withdrawing completely from UTHealth during a semester according to the following schedules. The percent refunded is based upon the full payment of all tuition and fees. If full payment has not been made, it is possible that a balance may be due. Not all fees are refundable beyond the first day of the term. Tuition reassessment refunds will be made after the 20th class day.

(Fall, Spring, 12-week Summer Semesters)

Prior to the first day of the session (a \$15 matriculation fee shall be assessed)	100%
During the first five class days of the term	80%
During the second five class days of the term	70%
During the third five class days of the term	50%
During the fourth five class days of the term	25%
After the fourth five class days of the term	None

(6-week Summer Semester)

Prior to the first day of the session (a \$15 matriculation fee shall be assessed)	100%
During the first, second, or third class days of the session	80%
During the fourth, fifth, or sixth class days of the session	50%
After the seventh day of class and thereafter	None

All policies regarding the payment or refund of tuition, fees and charges are approved by The University of Texas System Board of Regents and comply with all applicable state statutes. Students should contact the Bursar's Office on any clarification of matters relating to payment or refunds of all tuition, fees and other charges associated with their enrollment at UTHealth.

Bursar Office

The University of Texas Health Science Center at Houston
University Center Tower
7000 Fannin, Suite 2240
Houston, Texas 77030
713-500-3380

UTHealth Teaching Affiliations

UTHealth continually strives to increase the number of formal educational affiliation agreements with other institutions and agencies in the greater Houston area and the state, including a dozen major hospitals, city and neighborhood clinics, public schools, and other sites that provide settings for clinical services. These agreements allow students a multiple array of opportunities for educational growth in health-related fields.

Memorial Hermann Hospital is the primary teaching affiliate of the Medical School and the School of Dentistry. Memorial Hermann Hospital and the UTHealth work toward the goals of exemplary patient care, innovative teaching, community service, and productive research. The School of Dentistry operates general practice, pediatric dentistry, and oral and maxillofacial surgery clinics in conjunction with Memorial Hermann Hospital as part of the advanced dental education programs.

Lyndon B. Johnson General Hospital is a 332-bed full service general hospital staffed by faculty and residents of the UTHealth Medical School and School of Dentistry (oral surgery only). The hospital, owned and operated by the Harris County Hospital District, is medically staffed by Affiliated Medical Services, an organization formed through an agreement between the Medical School and Baylor College of Medicine.

The University of Texas MD Anderson Cancer Center and UTHealth, together with the Texas A&M Institute of Biosciences and Technology, collaborate extensively in research and education. Many of the MD Anderson Cancer Center faculty have joint appointments in most UTHealth units, and UTHealth students and residents gain clinical experience at MD Anderson Cancer Center in a variety of medical, dental and nursing specialties.

The UT Medical School at Houston has affiliations with institutions where residents are assigned, including St. Joseph Medical Center, for orthopedic surgery, psychiatry, radiology and urology; Harris County Psychiatric Center; St. Luke's Episcopal Hospital for anesthesiology, internal medicine, pathology, renal transplant and surgery; The Methodist Hospital for anesthesiology, colon and rectal surgery; Shriners Hospitals for Children—Houston for orthopedics; and Texas

Children's Hospital for radiology, anesthesiology, physical medicine and rehabilitation; and Woman's Hospital for Texas for obstetrics.

The UT School of Dentistry at Houston has affiliations with institutions for dental student, dental hygiene student, and resident rotations, and training. Hospital affiliations include Ben Taub General, LBJ General, Memorial Hermann, The Methodist Hospital, Shriners Hospital, St. Luke's Hospital, Texas Children's Hospital, The Institute for Rehabilitation and Research, U.T. MD Anderson Cancer Center, and the Veterans Affairs Medical Center. Community clinics and organizations include: Bering-Omega Clinic, City of Houston, Communities in Schools Houston, Denver Harbor Dental Clinic, East Texas Health Area Network (ETHAN), Fort Bend Family Health Center, Harris County, Harris County Hospital District, Houston ISD, San Jose Clinic, and St. Luke's Episcopal Health Charities.

The University of Texas Harris County Psychiatric Center has affiliations or program agreements with the UT School of Nursing; College of the Mainland (nursing); DeBakey High School for Health Professions (preceptorship program); Houston Baptist University (psychology and nursing); Houston Community College (Emergency Medical Technician (EMT) and nursing); Lee College (EMT and nursing); Prairie View A&M (nursing); San Jacinto College South (nursing); Stephen F. Austin State University (nursing and psychology); Texas Southern University (psychology, social work, and health information management); Texas Woman's University (nursing), Galveston College (Nursing); Alvin Community College (nursing); San Jacinto College (nursing); University of Houston (nursing, psychology, and social work); University of Houston-Clear Lake (psychology and counseling/educational psychology); UT Austin (social work); UT-El Paso (occupational therapy); and UT Medical Branch (nursing). Psychology residents from a variety of institutions are also trained.

UTHealth has academic affiliations with numerous universities in Latin America, Europe, and Asia that permit interested students to arrange, on an individual basis, periods of study or research abroad. We recognize that health and biomedical sciences are global in scope and encourage academic exchange with other countries and cultures.

Concurrent/Inter-Institutional Enrollment

The University of Houston, Texas Woman's University, UT Brownsville, UT at El Paso, UTMB Galveston, UTHSC at San Antonio, UT Austin, and UTHealth have concurrent enrollment agreements that allow students enrolled in one institution to enroll for support courses in another institution. Additionally, UTHealth has inter-institutional agreements with Rice University, Baylor College of Medicine, Texas A&M HSC-IBT and the Gulf Coast Consortia.

The mechanism for payment of tuition and fees vary according to the individual institution. Consult with the Registrar's Office for specific details at the following website:

<https://www.uth.edu/registrar/current-students/student-information/concurrentinter-institutional-enrollment.htm> or call 713-500-3388.

STUDENT GENERAL INFORMATION

Student Government

UTHealth authorizes the existence of a student government body that has the jurisdictions and powers delegated to it by The University of Texas System Board of Regents. The UTHealth student governance body is the Student InterCouncil (SIC), which is recognized as a forum of student opinion and is comprised of representatives from each of the six schools and includes representatives from traditionally underrepresented minority and international student constituencies.

The SIC contributes to the quality of student life at the university by participating in the development and implementation of policies and procedures affecting students, providing funds to support special projects of other student groups, representing student interests on external and internal committees, providing feedback to university administration on tuition and fee proposals, improving communication among the schools through the publication of an on-line student newsletter, Student Pulse, and planning and implementing activities that address the special needs of students.

Learn more about the Student InterCouncil at their website.

Website: <http://www.uthouston.edu/sic>

Student Organizations

UTHealth encourages its students, faculty, and staff to develop collegial relationships, and has established specific policies, based on UT System Board of Regents Rules and Regulations, that govern any organizations formed by those affiliated with the university.

A student organization that is registered with the UTHealth may have a membership composed only of students, faculty, and staff of all or particular schools or operating units. The organization may not suggest or imply that it is acting with the authority or as an agency of UTHealth or UT System.

Accordingly, a registered organization may not use the name of the university or the name of The University of Texas System as part of the name of the organization. An organization cannot display the UTHealth logo or the seal of either the UTHealth or The University of Texas System in connection with any activity of the organization or use such marks as part of any letterhead, sign, banner, pamphlet, or other printed material bearing the name of the organization. A registered organization may not have any person as a member who is not either a registered student or a member of the faculty or staff of UTHealth. The full UTHealth employee or student organizations policy can be found online in the Handbook or Operating Procedures (HOOP) Policy 110, Employee or Student Organizations (<http://www.uth.edu/hoop/policy.htm?id=1448068>). Students should contact their respective school's Office of Student Affairs for application instructions for annual renewal or new student organizations.

Student Fee Advisory Committee

The Student Fee Advisory Committee established pursuant to state law is charged with the responsibility of reviewing proposed tuition, student services, incidental, laboratory and other fee changes, and making recommendations to the university President before submission of new fee proposals to UT System for approval by the Board of Regents.

Student Guide

The Office of Academic and Research Affairs provides an informational resource website for students and prospective students that describes UTHHealth and community services, provides an overview of student policies and accompanying procedures, and information about the Texas Medical Center area.

The Student Educational and Program Services website is at <http://www.uthouston.edu/academics/applicants/index.htm>. For more information, contact the Office of the Executive Vice President for Academic and Research Affairs at (713) 500-3082.

UTHEALTH STUDENT SERVICES

Registrar

The UTHHealth Registrar's Office provides a central computer-based student record system and web registration activities and other services for schools on this campus. The goals of the office are to provide an effective and efficient application process; to direct an accurate, facile registration process; and to maintain a computerized applicant, student, and alumni record system.

Additional services provided by the Registrar's Office include the issuance of transcripts, certification of student status, degree verification, Veteran's Administration counseling and verification, residence determination, and enrollment verification. The office, in conjunction with the Office of International Affairs, assists foreign students in maintaining their student status.

For further information, contact:
Office of the Registrar
The University of Texas Health Science Center
at Houston
P.O. Box 20036
7000 Fannin, Suite 2250
Houston, Texas 77225
(713) 500-3388
email: registrar@uth.tmc.edu
Website: <https://www.uth.edu/registrar/>

Student Financial Services

UTHHealth has available grants, scholarships and loans based on the most current regulations or guidelines in effect at the time of award. Financial aid counselors are available Monday-Friday from 8:00 a.m. to 5:00 p.m. to provide counseling on the financial assistance programs available to students. The Office of Student Financial Services is located on the 22nd floor of the University Center Tower, 7000 Fannin, Houston, Texas 77030.

A student subject to selective service registration will be required to file a statement that the student has registered or is exempt from selective service registration in order to be eligible to receive financial assistance funded by state revenue.

Students can visit the Student Financial Services website at <http://www.uthouston.edu/SFS/financial-aid/attendance.htm> to find the latest information regarding Costs of Attendance and an example of Student Living Expense Budgets for current aid years.

The Texas Education Coordinating Board administers various tuition assistance programs including programs for teachers and vocational nursing students. Further information about these programs may be obtained by contacting the Office of Student Financial Services.

Please visit the financial services website for instructions on how to apply for financial aid or contact:

Office of Student Financial Services
The University of Texas Health Science Center
at Houston
P.O. Box 20036
7000 Fannin, Suite 2220
Houston, Texas 77225
(713) 500-3860
Website: <http://www.uthouston.edu/sfs/>

Office of the Bursar

The Office of the Bursar (also known as the Cashier's Office) has the responsibility for the assessment and collection of tuition and fees, processing institutional deposits, remission of tuition, fees and sales tax to the State, financial reporting, reconciliation of various revenue accounts and providing quality customer service to students, faculty and staff. The primary purpose of this office is to assess and collect tuition and fees from students and third party sponsors, including providing and maintaining multiple installment payment plans, issuing student identification badges, distributing financial aid, emergency loans and refunds. This office works closely with the Registrar and Student Financial Service offices to support the needs of the students.

The Office of the Bursar is also responsible for distributing special compliance notifications to students, such as set aside funds from designated tuition to be used for local institutional aid assistance programs and how the student can apply for those funds.

The Office is located in the UTHHealth University Center Tower (UCT) room 2240 at 7000 Fannin, Houston, Texas 77030. Office hours are Monday-Friday, 8:00am-5:00pm. For questions regarding student accounts, tuition and fee payments, refunds, or installment plans students may call 713-500-3088.

Bursar Website: <https://inside.uthouston.edu/finance/bursars/>

Office of International Affairs

The Office of International Affairs (OIA) serves as the internal institutional resource to facilitate and oversee institutional compliance with state, local and federal laws and regulations regarding the immigration status of all non- U.S. citizens who participate in the academic, research, and clinical endeavors of The University of Texas Health Science Center at Houston.

Services and programs offered include:

- Advice on immigration issues to university units wishing to host or employ international visitors;
- Institutional compliance with immigration regulations;
- Processing of non-immigrant and immigrant visa applications sponsored by the institution;
- Acting as a liaison among institutional departments, government agencies, and private organizations; and
- Coordinating educational and cultural programs and activities that promote the well-being of international visitors, students, trainees, faculty, and staff.

To ensure compliance with federal, state, and local regulations as well as institutional policies, all non-U.S. citizens must check-in with the Office of International Affairs prior to registering for classes in order to obtain the appropriate clearance to begin studies.

The Office of International Affairs is located in the University Center Tower, Suite 130. Office hours are Monday through Friday from 8:00 a.m. to 5:00 p.m. Appointments are required.

For further information, contact:

Office of International Affairs

The University of Texas Health Science Center at Houston

P.O. Box 20036

Houston, Texas 77225

7000 Fannin St., Suite 130

Houston, Texas 77030

(713) 500-3176 FAX (713) 500-3189

email: utoiahouston@uth.tmc.edu

Website: <http://www.uthouston.edu/international-affairs/>

Office of Equal Opportunity

- The Equal Opportunity Office within Human Resources (HR-EO) provides resources and advice to the university community. Key functions include: Investigating complaints of discrimination and harassment based on race, color, religion, national origin, sex, age, sexual orientation, mental or physical disability, genetic information, veteran's status, or any other basis protected by applicable university policy and/or law.
- Working with supervisors and 504 Coordinators to evaluate requests for reasonable work and/or academic accommodation under university policy and/or applicable law;
- Educating hiring officials on best practices for attracting, hiring, and retaining a diverse workforce;

- Preparing the university's affirmative action plans and reporting other demographic data as required by state and federal law;
- Promoting an inclusive environment by delivering training on equal opportunity, discrimination & harassment, affirmative action, diversity and other topics as appropriate for the university community.

For additional information, contact:
The University of Texas Health Science Center at Houston
Human Resources
7000 Fannin, Suite 150
Houston, Texas 77030
(713) 500-3079
Website: <http://hr.uth.tmc.edu/EEOnew/eo.html>

Student Health and Counseling Services

Student Health Services serves as the medical home for all UTHealth students and provides both medical and mental health services. A portion of the student services fee funds the programs.

Medical Services:

The medical health services are available for all UTHealth students and their dependents. Dependents services are billed directly to their insurance. Services available include immunizations required for matriculation into and through UTHealth, tuberculosis screening, physical examinations, well woman examinations, flu shots, travel medicine, treatment of acute and chronic medical problems, and referrals to specialists as necessary. The clinic manages a 24-hour a day hotline for needlesticks and other exposures to hazardous body fluids. An on-site Class D pharmacy offers many prescription medications for common illnesses and oral contraceptives. The clinic is staffed by physicians who are board certified both in Internal Medicine and Pediatrics.

Low complexity office visits are covered by the student fees. Higher complexity visits can be charged to the student's insurance carrier. Immunizations may be covered by the student's insurance and if not, are offered at near cost. Testing following blood or body fluid exposure while performing educational assignments is covered by the Needlestick Program as long as student reports incident to our Occupational Exposure Hotline at (713) 500-OUCH. Any charges not covered by the student's insurance carrier are the responsibility of the student. These may include laboratory tests, radiological services, hospitalization and referred consultation, and pharmaceuticals.

Psychiatric and Counseling Services:

The university understands that balancing personal life with the demands of academia can be challenging. Psychiatric and counseling services are available for all UTHealth students at no additional cost. Available services include therapy sessions for a wide variety of concerns such as depression, anxiety, academic problems, alcohol abuse, drug problems, eating disorders, insomnia, relationship concerns, smoking cessation, suicidal thoughts, psychotic behavior, etc. Referrals are not required and students are strongly encouraged to call and make an appointment if they are in need of these services.

Records are kept strictly confidential to the extent allowed by the law. Our staff is available for outreach and prevention programs for all UTHealth schools.

Student Health Services is located in the UT Professional Building, Suite 130. Office hours are 8:30 a.m. to 5:00 p.m. Appointments are preferred but not required for acute illness and emergencies.

For more information, contact:

UT Student Health Services

The University of Texas Professional Building

6410 Fannin, Suite 130

Houston, Texas 77030

(713) 500-5171 FAX (713) 500-0605

Website: <http://www.uthouston.edu/studenthealth>

Student Health Insurance

The University of Texas System Board of Regents approved mandating health insurance for students enrolled in the UT System health components, including students previously enrolled. The Board of Regents has authorized the assessment of a health insurance fee for each semester to each student who cannot provide evidence of continuing coverage under another approved plan.

In addition, the Board of Regents requires all international students holding non-immigrant visas and living in the United States to have coverage for repatriation and medical evacuation while enrolled at The University of Texas System component institutions. The required health insurance fee assessed by the university includes coverage for repatriation and medical evacuation. International students with coverage outside of the plan can contact UTHealth Auxiliary Enterprises at (713) 500-8400, or student-insurance@uth.tmc.edu to provide the information needed to waive the insurance fee and, if needed, purchase coverage for repatriation and medical evacuation.

A student health insurance program is offered to registered students through a private company selected by The University of Texas System. This plan is designed to supplement student health services. In addition, it also assists with expenses not covered by the student services fee such as prescriptions, hospitalization, etc. Students have the option of enrolling their families in this plan at an additional cost.

For further information, contact: Auxiliary Enterprises

The University of Texas Health Science Center at Houston

7779 Knight Road

Houston, Texas 77054

(713) 500-8400 FAX (713) 500-8409

email: student-insurance@uth.tmc.edu

Website: <http://www.uth.edu/auxiliary-enterprises/insurance>

Child Development Center

UTHealth operates a Child Development Center (CDC) for children ages six weeks through kindergarten, located within the University Housing complex at 7900 Cambridge. The Center offers a safe, wholesome environment where children enjoy living and learning. The educational environment for infants is designed to provide visual and auditory stimulation in an atmosphere of warmth and nurturance. The program for toddlers and older children features open learning centers that provide for individual instructional activities with large and small group interaction. All children are encouraged to develop according to their own unique abilities, interests and growth rates.

In addition to being licensed by the State of Texas, the CDC is nationally accredited by the Southern Association of Colleges and Schools (SACS). The CDC program was the first nationally accredited center in the Texas Medical Center. Each classroom has a lead teacher with an Associate's or Bachelor's degree in Child Development or related field, and our Kindergarten teacher has a Master's degree. The CDC is open from 6:00 a.m. to 6:00 p.m., Monday through Friday, and is closed on all UTHealth holidays.

Parents are encouraged to participate in various projects involving their children and in the activities of the Building Blocks Committee, which acts as a support group for the CDC. Regularly scheduled parent/teacher conferences apprise parents of their child's growth and development..

Tours are available Tuesday, Wednesday and Thursday from 9:00 a.m. until 4:00 p.m.

Child Development Center
The University of Texas Health Science Center
at Houston
7900 Cambridge
Houston, Texas 77054
(713) 500-8454
Website: <https://www.uth.edu/child-development-center/>

University Housing

University Housing consists of three unique apartment communities. Each apartment is carpeted and equipped with an all-electric kitchen. The Phase I complex was built in 1982 and features first and second floor units in one, two, and three bedroom floor plans. Phase I offers coin-operated washers and dryers housed in three laundry rooms.

The Phase II property, built in 2005, is a contemporary style living environment with four floors of one and two bedroom apartments and a four-story parking garage located in the middle of the complex. . Each unit in Phase II has its own washer and dryer.

Phase III, to be finished in May of 2014, was built in the same style and offers the same amenities of the Phase II property. The entrance to all three properties is monitored by a 24-hour guard. Residents enjoy the amenities of a commons room, swimming pool and close proximity to the Child Development Center, the Recreation Center and the UTHealth shuttle.

Leasing office hours are from 8:30 a.m. to 5:30 p.m. Monday through Friday.

Affiliated students, faculty, and staff are encouraged to apply for a place on the waiting list for available vacancies.

For further information contact:
University Housing
The Leasing Office
1885 El Paseo
Houston, Texas 77054
(713) 500-8444 FAX (713) 500-8448
Website: <http://www.uth.edu/housing>

Transportation

UTHealth provides a circulator shuttle for all UTHealth students, faculty and staff. UTHealth identification badges are required for access onto the shuttle. The shuttle service is contracted through Groome Transportation and operates from 6:00 a.m. to 8:30 p.m. Monday through Friday, excluding official university holidays. During peak operating hours (6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m.), the shuttle runs every 10-15 minutes. Shuttle stops are located at: University Housing, Recreation Center, University Center Tower, School of Nursing, Graduate School of Biomedical Sciences, Medical School Building, School of Public Health, and the Research Park Complex. The real-time location of each shuttle can be tracked online at <http://uthpublic.etaspot.net> or <http://uthmobile.etaspot.net> (for mobile devices). For information regarding shuttle services or routes, please contact Auxiliary Enterprises at shuttle@uth.tmc.edu or visit the website at <http://www.uth.edu/shuttle>.

In addition to the UTHealth Shuttle, the Texas Medical Center (TMC) operates a free shuttle from its various locations. For information about TMC shuttle service, see www.texasmedicalcenter.org or call the TMC Parking Office at (713) 791-6161.

Vehicles parking or driving on property controlled by UTHealth are subject to enforcement of state vehicle inspection laws.

General Parking Information for UTHealth Students

Students may obtain contract parking from UTHealth or the Texas Medical Center (TMC). For UTHealth student parking information, call 713/500-3405 or visit www.uth.edu/parking (under the Parking tab, click on Student Parking Policy). For TMC information, call 713/791-6161 or visit www.texasmedicalcenter.org (under the Parking & Transportation tab select Contract Parking). Reduced rate parking is available at these remote lots: UT South Campus Lot, TMC South Extension Lot, TMC Smith Lands and TMC South Main Lot. Some remote parking lots offer free shuttle service to the main campus and “after hours” privileges to park in the main campus garages. UTHealth On-Campus Parking:

University Center Tower (UCT) Garage (7000 Fannin at Pressler): Full-access contract parking at the UCT garage is available only to employees and students in the UCT and Institute of Molecular Medicine (IMM) buildings. However, after-hours parking contracts are available to all students (see below). In addition, all currently enrolled students who visit UCT for student-related business (i.e., Registrar, financial aid, and Bursar’s office) are granted complimentary parking for one and a half hours. Before leaving the building, the student must present a valid student ID badge and parking ticket to the Parking Office on the first floor of UCT to obtain

validation to exit the garage. Parking in excess of the 1-1/2 hour complimentary parking is at the student's expense.

University Professional Building (UPB) Garage (6414 Fannin): Full-access contracts are not available to students at the UPB Garage. However, after-hours contracts are available (see below). The Prairie View A&M University (PVAMU) Garage at 6436 Fannin (next to UPB Garage) offers 24/7 month-to-month parking contracts to UTHHealth students on a first-come, first-serve basis. Students may purchase a parking contract for PVAMU by presenting a valid student ID at the UPB Parking Office. **UT South Campus Lot:** The South Campus Lot, located across from the University Recreation Center, is available to all students 24/7 at a rate of \$40 per month. The UTHHealth Shuttle picks up directly in front of the South Campus Lot and stops at key points around campus. The South Campus Lot is also in walking distance to the UTHHealth School of Dentistry (SOD). South Campus contracts include after-hour access to the Research Park Complex (RPC) Lot located directly in front of SOD.

Research Park Complex (RPC) Lot: The RPC Lot, located across from the UTHHealth School of Dentistry, is not available for full access student contract parking. However, after-hours and weekend access to the RPC Lot is included with the purchase of contract parking at the UT South Campus Lot.

SON/SPH Lots: The SON/SPH lots adjacent to the UTHHealth School of Nursing and the UTHHealth School of Public Health are not available for full access student contract parking. However, after-hours contracts are available (see below).

After-Hours Parking Contracts are available for UCT Garage, UPB Garage and SON/SPH lots. These contracts allow parking at the designated facility Monday through Friday from 5:00 pm to 8:00 am, or any time on weekends. The cost for an after-hours parking contract is \$30 per six-month period (January-June and July-December) plus a one-time non-refundable parking card activation fee of \$10. (Please note, after-hours parking at RPC Lot is included with the purchase of a full-access contract at UT South Campus.)

For further information contact:

UTHealth Parking Services UCT
7000 Fannin (UCT)

Houston, Texas 77030

(713) 500-3405

email: Parking@uth.tmc.edu

Website: www.uth.edu/parking

UTHealth Parking Services UPB

6414 Fannin (UPB)

Houston, TX 77030

(832) 325-7655

Alternative Transportation Options

Van Pool Info: METRO Star offers a monthly subsidy per van pool riders who ride at least twelve times per month round trip. The subsidy is provided direct to the van pool driver's account and the savings passed on to the rider. To form or join a van pool, register on METRO's online website at www.ridemetro.org or call METRO at (713) 224-RIDE (7433).

METRO: METRO offers a 50% discount off the full fare for all local Park and Ride or METRO Rail rides. Student must obtain a letter showing you are a registered student of the university. The letter can be obtained by presenting a current UTHHealth ID Badge at one of the UTHHealth Parking Offices: UCT-7000 Fannin or UPB-6414 Fannin. The letter and student ID must then be taken to the METRO Ridestore, 1900 Main Street, 1st floor, to obtain a pictured METRO QCard. METRO is

open Monday through Friday, 8:00 am to 5:00 pm, and can be reached by riding the METRO Rail Line to Downtown Transit Center stop. Contact METRO at (713) 739-6968 for more information.

For additional information, please contact UTHHealth Parking at

Email: Parking@uth.tmc.edu

Website: <http://www.uth.edu/parking>

Bookstores

Matthews Medical Book Company operates three locations at UTHHealth – Medical School, School of Dentistry and School of Nursing.

A student of this institution is not under any obligation to purchase a text-book from a university-affiliated bookstore. The same textbook may also be available from an independent retailer, including an online retailer.

Each bookstore location carries required and recommended textbooks for affiliated school, relevant reference and review materials, equipment and supply kits, and computer software. UTHHealth gift and clothing items, graduation invitations, academic regalia and diploma frames are also available. Books that are not in stock may be special ordered at the service desk or online. For further information, contact:

Matthews UTHHealth Medical School Bookstore
The University of Texas Health Science Center at Houston
6431 Fannin, Suite B600
Houston, TX 77030
(713) 500-5860 FAX (713) 500-0540
Website: <http://www.uthoustonbooks.com>
Hours of operation: 8:30 am to 5:00 pm Monday to Friday

Matthews UTHHealth School of Dentistry Bookstore
The University of Texas Health Science Center at Houston
7500 Cambridge
Houston, Texas 77054
(713)846-4450
Website:<http://www.uthoustondental.com>
Hours of operation: 8:00 am to 4:30 pm Monday to Friday

Matthews UTHHealth School of Nursing Bookstore
The University of Texas Health Science Center at Houston
6901 Bertner, Room 280
Houston, Texas 77030
(713)500-9561 FAX (713)500-0982
Website: <http://www.uthoustonnursing.com>
Hours of operation: 8:30 am to 5:00 pm Monday to Thursday, 8:30 am to 4:30 pm Friday

University Dining and Catering Services

Food Service locations are provided at the School of Nursing, School of Dentistry and Medical School buildings through a contracted provider. Catering is available through the School of Nursing location. Vending is also contracted with machines located throughout the UTHealth campus.

Phone: 713-500-8405
Catering: 713-500-9103

Website: www.uth.edu/dining-catering

School of Nursing The cafeteria is located on the first floor of the School of Nursing Building at 6901 Bertner Avenue. A variety of dining choices are available for your convenience.

Call for catering needs throughout the university. Phone: 713-500-9103

School of Dentistry The grab-n-go is located on the ground floor of the School of Dentistry at 7500 Cambridge. A limited variety of dining choices are available along with a selection of specialty coffee drinks.

Medical School The grab-n-go is located on the ground floor of the Medical School Building at 6431 Fannin. A limited variety of dining choices are available along with a selection of specialty coffee drinks.

Hours of Operation (excluding university holidays): Monday - Friday 7:00 a.m. - 3:00 p.m.

Recreation Center Facilities and Programs

The UT Recreation Center, adjacent to the University Housing Complex, offers quality recreational and athletic facilities featuring a variety of programs and equipment designed for health and fitness as well as fun and relaxation.

Programs consist of personal training, motivational and incentive programs, group fitness classes, American Heart Association CPR/AED and First Aid Certifications, team and individual recreational sports and seasonal swim lessons all centered upon the facilities:

- Heated outdoor Olympic size pool
- Strength training equipment
- Cardiovascular equipment w/individual TVs, personalized tracking programs and Wi-Fi
- Leisure games – Tennis and Billiards
- Racquetball Court
- Outdoor basketball courts
- Tennis courts
- Volleyball courts
- Athletic fields – softball, football, soccer and recreational activities (seasonal)
- Trail and fitness stations

Membership is open to all UTHealth students, faculty, staff and affiliates, including institutions of the Texas Medical Center, and UT System Alumni and associated families. For current UTHealth students, the membership is already included in the student service fees. A valid TMC institutional ID or proof of alumni status is required at time of purchase and renewal of any

services offered. Memberships are offered on a monthly, quarterly or yearly basis for individuals or families. Family memberships extend to the main member's spouse and all dependents up to the age of 20 (children under 16 must be accompanied and supervised by a parent or guardian at all times while using the facilities). Summer Family Packages are available for pool use. The facility is open seven days a week, closing only for major university holidays. For minor holidays, hours may be reduced, but will be announced in advance. Hours are Monday through Friday, 5:30 am to 10:00 pm, Saturday 8:00 am to 8:00 pm, and Sunday 10:00 am to 8:00 pm. The Recreation Center pool always closes 30 minutes prior to the facility.

For further information, please contact: UTHealth Recreation Center
The University of Texas Health Science Center at Houston
7779 Knight Road
Houston, Texas 77054
(713) 500-8420
Website: <http://www.uth.edu/recreation-center>

MD ANDERSON STUDENT SERVICES

Students in the UT Graduate School of Biomedical Sciences have access to student services at both UTHealth and MD Anderson. The office of the Vice President for Academic Affairs at MD Anderson provides oversight, coordination and management for student services at MD Anderson.

For more information contact:
Office of Academic Affairs
The University of Texas MD Anderson Cancer Center
1515 Holcombe Blvd., Unit 147
Houston, TX 77030-4009
(713) 792-0873 FAX (713) 792-2169

Registrar

All graduate students in The University of Texas Graduate School of Biomedical Sciences at Houston are provided student record system and registration activities and other services by the Health Science Center Registrar's Office.

Student Financial Services

All graduate students in The University of Texas Graduate School of Biomedical Sciences at Houston are provided financial aid specialists and counseling on financial assistance programs by the Health Science Center Office of Student Financial Services.

Office of International Affairs

The UTHealth Office of International Affairs serves the needs of non-U.S. citizens, faculty, students, fellows and staff at the UTHealth. Students with visas who rotate to MD Anderson must check-in at the MD Anderson Visa Office.

Office of the Chief Diversity Officer

Both UTHealth and MD Anderson are committed to enhancing diversity. At MD Anderson, the Chief Diversity Officer reports to the Vice President for Human Resources and has the responsibility for ensuring that MD Anderson promotes diversity as a way of life and meets its obligations as an Affirmative Action and Equal Employment Opportunity employer and educational institution.

Emergency Health Services

MD Anderson provides emergency health services for on-site student injuries.

Employee Assistance Program

The Employee Assistance Program (EAP) managed by MD Anderson Human Resources provides confidential assistance to educational appointees and immediate family members to resolve problems that affect their personal lives and performance and for personal legal matters. EAP offers professional assessment, guidance and referral services.

Employee Wellness and Programs Departments

These departments, managed by Human Resources, provide fitness programs, weight and wellness programs, individual coaching/counseling, and seasonal social events and sports programming for all employees including educational appointees.

Website: <http://www.mdanderson.org/about-us/for-employees/employee-resources/employee-health-and-well-being/programs-and-services/employee-health-well-being-programs-services-wellness-works-award.html>

Scientific Publications

The MD Anderson Office of Scientific Publications serves as a resource for all MD Anderson-based students and provides assistance to students in writing and editing scientific articles and grants with a faculty author at MD Anderson.

Website: <http://www.mdanderson.org/education-and-research/departments-programs-and-labs/departments-and-divisions/scientific-publications/index.html>

Faculty Development

Dedicated to enhancing the professional development and career satisfaction of faculty and trainees, Faculty Development offers a variety of programming, online learning resources and personal assistance tailored to their unique needs. Students' career development needs are considered in the design of many of these programs and resources, and all students are encouraged to attend the open events advertised.

Website: <http://www.mdanderson.org/education-and-research/education-and-training/faculty-academic-development/index.html>

Trainee and Alumni Affairs

Trainee and Alumni Affairs provides leadership, guidance and support to MD Anderson departments, programs, trainees, students, alumni and external regulatory agencies, thereby promoting positive educational experiences throughout the institution.

Website: <http://www.mdanderson.org/education-and-research/education-and-training/trainee-and-alumni-affairs/index.html>

Job Search Assistance

Job posting databases on the graduate school and MD Anderson websites and institutional subscriptions to Science Netwave and other cancer sites are available to all students.

Websites: <https://gsbs.uth.edu/careers/index.htm> <http://www3.mdanderson.org/library/>

Other UTHealth-Provided Student Services

Student Health Services, Student Health Insurance, UT Counseling and Worklife Services, Child Development Center, University Housing, Transportation and Parking, Bookstore, Dining and Catering Services, Recreation Center Facilities and Programs, and the Houston Academy of Medicine-Texas Medical Center Library are also available to all students in the Graduate School of Biomedical Sciences regardless of whether their supervisory professor has a shared faculty appointment at UTHealth or MD Anderson.

UTHEALTH AND MD ANDERSON POLICY INFORMATION FOR GSBS STUDENTS

Policy Information for Students

All students are admitted into The University of Texas Graduate School of Biomedical Sciences at Houston (GSBS), rather than into departments at UTHealth or MD Anderson. During their first and subsequent years of study, students take classes in the GSBS taught by faculty who hold both an appointment in the GSBS and also hold a faculty appointment in either UTHealth or MD Anderson, or Texas A & M University's Institute of Biotechnology. Also in their first year, students take three tutorial rotations selected from among all GSBS faculty.

As both MD Anderson and UTHealth are State of Texas agencies and sister academic institutions in The University of Texas System, the academic policies governing students and faculty are fundamentally similar. GSBS faculty and both institutions' administrations have agreed that students in the GSBS will be governed in academic matters by the policies in the UTHealth Handbook of Operating Procedures and The University of Texas Board of Regents' Rules and Regulations.

GSBS students who hold a Graduate Research Assistantship must follow the employment policies of the academic institution in which they have their appointment. When students rotate at MD Anderson or select a faculty supervisor who holds an appointment at MD Anderson there are some all-employee policies at MD Anderson, for example the immunization policy, that may differ from those of UTHealth and that do apply to GSBS students at MD Anderson.

The following excerpts and policy descriptions from the UTHealth Handbook of Operating Procedures

(HOOP) are from selected policies that relate to student life. Additional student policies can be found in the HOOP located at <https://www.uth.edu/hoop/disposition-table.htm>

In an educational community as large as The University of Texas System, formal policies and procedures must exist to facilitate the orderly conduct of affairs. The University of Texas System Board of Regents' Rules and Regulations (<http://www.utsystem.edu/board-of-regents/rules.htm>) reflect the general policies and rules set forth by The University of Texas System Board of Regents and apply to all institutions within the UT System. The HOOP implements the rules of governance and administrative procedures for UTHealth within the guidelines of the policies set forth by The University of Texas Board of Regents' Rules and Regulations.

STUDENTS (INCLUDING RESIDENTS AND FELLOWS) ARE CHARGED WITH THE RESPONSIBILITY FOR KNOWLEDGE OF AND COMPLIANCE WITH ALL UTHealth POLICIES, REGULATIONS AND PROCEDURES, INCLUDING, AS APPROPRIATE, POLICIES, REGULATIONS, AND PROCEDURES UNIQUE TO THE INDIVIDUAL SCHOOL OR PROGRAM IN WHICH THE STUDENT IS ENROLLED OR PARTICIPATES

For additional information on policies specific to individual schools, contact the Student Affairs Office in your school or access the individual school's website from links provided on the UTHealth home page at <https://www.uth.edu/>.

Educational Records and Family Educational Rights and Privacy Act (FERPA)

The University of Texas Health Science Center at Houston complies with the Family Educational Rights and Privacy Act of 1974 (FERPA), which protects the privacy of educational records and establishes the rights of students to access of their educational records. The Registrar will annually notify students of their rights and the procedures for exercising these rights.

The full policy can be found in HOOP Policy Number 129, Educational Records. <https://www.uth.edu/hoop/policy.htm?id=1448106>.

The link to the full text of FERPA can be found on the on the Registrar's website at <https://www.uth.edu/registrar/current-students/student-information/ferpa.htm>

All research papers, theses, and dissertations authored by degree candidates are available to interested members of the general public upon request

AIDS, HIV, HBV, and HCV Infection

UTHealth works to help safeguard the health and safety of students, employees, patients, and the general public against the contact and spread of infectious diseases. The UTHealth is also sensitive to the needs and rights of any of its employees or students who have contracted diseases that might be infectious. In recognition of Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV) as serious public health threats, the UTHSC-H has adopted policy and procedural steps to both prevent the spread of HIV, HBV, and HCV infections and to protect the rights and well-being of those employees or students who may be infected with communicable diseases. The full HOOP policy, which defines terms and addresses general principles, voluntary counseling and testing, work-related exposure, and educational efforts, can be found in HOOP Policy Number 158, Bloodborne Pathogen Infection Control. <http://www.uth.edu/hoop/policy.htm?id=1448164>

Campus Security

UTHealth is committed to a safe and secure learning and working environment. To that end, the university strives to assure that its buildings and contents are secure and that members of the university community are properly identified and are given appropriate access to university facilities and amenities. Campus security policies can be found online in HOOP Policy Number 2, Campus Security <https://www.uth.edu/hoop/policy.htm?id=1447852>

In compliance with the Student Right-to-Know and Crime Awareness and Campus Security Act, UTHealth collects specified information on campus crime statistics and makes timely reports to the campus community on crimes considered to be a threat to students and employees. The University of Texas at Houston Police Department provides a link to crime statistics on its website at <http://www.mdanderson.org/utpd/>.

Guidance on reporting criminal activity on campus can be found online in HOOP Policy Number 87, Reporting Criminal Activity on Campus <http://www.uth.edu/hoop/policy.htm?id=1448022>

Making a False Alarm or Report

A person commits an offense under Section 42.06, Texas Penal Code, if he or she knowingly initiates, communicates or circulates a report of a present, past, or future bombing, fire, offense, or other emergency that he or she knows is false or baseless and that would ordinarily: (1) cause action by an official or volunteer agency organized to deal with emergencies; (2) place a person in fear of imminent serious bodily injury; or (3) prevent or interrupt the occupation of a building, room, place of assembly, place to which the public has access, or aircraft, automobile, or other mode of conveyance. The offense under Section 42.06, Texas Penal Code, of making such a false alarm or report involving a public or private institution of higher education is a state jail felony. An individual adjudged guilty of a state jail felony shall be punished by confinement in a state jail for any term of not more than two years or less than 180 days and, in addition to confinement, an individual adjudged guilty of a state jail felony may be punished by a fine not to exceed \$10,000.

Conduct and Discipline

All UTHealth students are expected and required to obey federal, state, and local laws; to comply with the Regents' Rules and Regulations, the rules and regulations of UTHealth, and directives issued by administrative officials of the university or UT System in the course of their authorized duties, and to obey standards of conduct appropriate for an academic institution. Any student who engages in conduct that violates UTHealth or UT System policies or rules, or federal, state, or local laws is subject to discipline whether the conduct takes place on or off campus and whether or not civil or criminal penalties are imposed for such conduct.

The full student conduct and discipline policy can be found online in HOOP Policy Number 186, Student Conduct and Discipline <http://www.uth.edu/hoop/policy.htm?id=1448220>

Copyrighted Material and Software

All employees and students of The University of Texas Health Science Center at Houston must comply with United States Copyright Law of 1976, as amended, (Title 17, United States Code) ("Copyright Act") including UTHealth policies and guidelines governing the use of copyrighted materials. All students are responsible for knowing the laws that govern copyrighted materials

which are outlined in HOOP Policy Number 47, Classroom and Research Use of Copyrighted Material at <http://www.uth.edu/hoop/policy.htm?id=1447942>.

Both uploading and downloading files can potentially violate copyright laws. Students should be cautious and research whether the source provides material licensed by the copyright owner. Links regarding Peer-to-Peer file sharing and potential copyright infringement can be found on the UTHHealth Information Technology website at <http://it.uth.tmc.edu/cio/index.htm>, under the heading of Cyber-Security Tips (US-CERT).

UTHealth must also comply with current copyright laws pertaining to computer software provided in federal law and with software license agreements. Any use of university computers and/or computer peripherals by students or employees for unauthorized duplication of copyrighted or licensed works is subject to appropriate disciplinary action as well as those civil remedies and criminal penalties provided by federal and state laws. Detailed information on Software Copyright Compliance can be found in HOOP Policy 198 at <http://www.uth.edu/hoop/policy.htm?id=1699026>

In addition to potential civil and criminal penalties established by federal law, each UTHealth school may impose student disciplinary actions where appropriate in accordance with university policies governing student conduct and discipline.

Criminal Background Checks - Students

UTHealth is committed to providing a safe environment for its students and employees. The university obtains criminal background information regarding applicants for security sensitive positions. The university has determined that all positions (whether employee or student) within the university are security sensitive. Increasingly, a criminal background check is being required by clinical facilities at which students enrolled in clinical programs receive education and training. Furthermore, some licensing boards in Texas require criminal background checks before issuing a license to practice. Individuals who are unable to meet the university's criminal history standards may be denied admission or continued enrollment in the program.

Enrolled students may be required to consent to additional criminal background checks for clinical placement or other purposes at the discretion of the Dean of each school.

The full policy can be found online in HOOP Policy Number 160, Criminal Background Checks <http://www.uth.edu/hoop/policy.htm?id=1448168>

Disability Accommodation

UTHealth is committed to providing equal opportunities for qualified employees, job applicants, and students with disabilities in accordance with state and federal law.

Student applicants and enrolled students can obtain information concerning program-related accommodations in each school from the school's Section 504 Coordinator (usually found in the Student Affairs office of each school). The Disability Coordinator (in Human Resources) and the Section 504 Coordinators can provide information and referrals regarding campus accessibility, disabled parking permits, transportation services, and other resources.

The full policy can be found online in HOOP Policy Number 101, Disability Accommodation <http://www.uth.edu/hoop/policy.htm?id=1448050>

Equal Educational Opportunity

UTHealth endeavors to foster an educational environment and working environment that provides equal opportunity to all members of the university community. To the extent provided by applicable law, no person shall be excluded from participation in, denied the benefits of, or be subject to discrimination under, any program, or activity sponsored or conducted by The University of Texas System or any of its institutions on the basis of race, color, national origin, religion, sex, age, veteran status, or disability.

Any student or potential student who has a complaint under this policy should contact the associate dean for student affairs in his or her school, the executive vice president for academic and research affairs, or the Office of Human Resources.

The full policy can be found online in HOOP Policy Number 183, Equal Opportunity, Discrimination and Harassment <http://www.uth.edu/hoop/policy.htm?id=1448214>

Hazing

Hazing is prohibited by both state law, by HOOP Regents' Rules and Regulations (Rule 50101). Individuals or organizations engaging in hazing could be subject to fines and charged with criminal offenses. Additionally, the law does not affect or in any way restrict the right of the University to enforce its own rules against hazing.

The term "hazing" is broadly defined by statute to mean any intentional, knowing, or reckless act, occurring on or off UTHealth property, by one person alone or acting with others, which endangers the mental or physical health or safety of a student for the purpose of pledging, being initiated into, affiliating with, holding office in, or maintaining membership in any organization whose members are or include students at the university. Hazing with or without the consent of the student is prohibited and violations may render both the person inflicting the hazing and the person submitting to the hazing subject to criminal prosecution and student disciplinary action by UTHealth.

Student Immunizations and Health Records

All students registering at The University of Texas Health Science Center at Houston (UTHealth) are required to furnish an immunization record signed by a health care provider. An immunization hold is automatically placed on an applicant's record at the time of an applicant's acceptance to UTHealth. The UT Student Health Clinic will release all immunization holds after proof of immunizations is satisfied. The UT Student Health Clinic may place a hold on a student's record at any time if a student fails to comply with the requirements of this policy.

The following immunizations and screening tests are required for all students at The University of Texas Health Science Center at Houston:

- Tuberculin Skin Test must be done within the past 12 months, even for those who have received BCG vaccine as a child. If current or former PPD skin test is positive a chest x-ray, taken within the past 12 months, documenting no active tuberculosis must be submitted with immunization form;
- Measles – proof of two doses of measles vaccine administered on or after the first birthday and at least 30 days apart or proof of immunity;

- Mumps – proof of one does of mumps vaccine administered on or after the first birthday or proof of immunity;
- Rubella – proof of one does administered on or after the first birthday or proof of immunity;
- Tetanus/Diphtheria and Pertussis – proof of one “booster” dose within the past 10 years;
- Hepatitis B virus (HBV) – proof of serologic immunity to HBV or certification of immunization with a complete series of hepatitis B vaccine. Student must be vaccinated to most current status possible prior to registering for classes;
- Varicella (chickenpox) – Physician validated history of the disease or proof of two dose vaccine series or lab report of positive varicella titer. If varicella titer is negative, varicella vaccine series is required; and,
- Meningococcal (Meningitis) – Required of all incoming and transfer students 21 years old and younger. Students must have been immunized within the past five years and submit proof of immunization at least ten days prior to the first day of class.

****Important information regarding the Meningococcal Vaccine****

Texas law mandates that Texas universities and health science centers require all new and transfer students show proof of vaccination against bacterial meningitis. The law does not apply to new and transfer students who are over the age of 21 at the time of enrollment or who are enrolled only in distance learning classes.

The only exceptions permitted by law are for:

1. Students who can provide proof that a health care provider has determined that it would be a health risk for the student to have the vaccine; or,
2. Students who use the Exemption Form issued by the Texas Department of State Health.

Obtaining the required form from the Texas Department of Health Services to establish an exemption for reasons of conscience is a time-intensive process that takes approximately a month. A student anticipating using this exemption should start this process early. An online exemption request form can be found on the Texas Department of State Health Services website at <http://www.dshs.state.tx.us/immunize/school/default.shtm#exclusions>.

A student who previously attended a UTHHealth school or another institution of higher education before January 1, 2012 and is re-enrolling following a break in enrollment of at least one fall or spring semester must fulfill the meningitis vaccine requirement.

For more information on immunizations or how to obtain certain required immunization exemptions students are requested to contact the UT Student Health Clinic at (713) 500-5171 or visit their website at <http://www.uthouston.edu/studenthealth>.

The full policy, which lists required immunizations and procedures for requesting exemptions from required immunizations, can be found in HOOP Policy Number 55, Student Immunizations and Health Records <http://www.uth.edu/hoop/policy.htm?id=1447958>

Determination of Resident Status

Before an individual may register at UTHealth and pay tuition at the rate approved for residents of the State of Texas, the individual must provide required information regarding their residency status. The Registrar is the Residency Determination Official for the university. The full policy can be found online in HOOP Policy Number 58, Determination of Resident and Non-Resident Tuition Status <http://www.uth.edu/hoop/policy.htm?id=1447964>.

Information about the Petition for Resident Tuition and a link to the Core Residency Questionnaire can be found on the Registrar's Website at: <https://www.uth.edu/registrar/current-students/student-information/policy-for-texas-resident-tuition.htm>

Absences

Observance of a Religious Holy Day: Students who wish to observe a religious holy day that interferes with classes, examinations or completion of assignments, must inform the instructor of each class to be missed and/or of the planned absences(s) not later than the fifteenth day of the semester. The notification must be in writing and may either be delivered by the student personally to each instructor, with receipt of the notification acknowledged and dated by each instructor, or mailed by certified mail, return receipt requested, to each instructor. Pursuant to Texas law, a request to observe a religious holy day may be denied if the student's absence will interfere with clinical care.

As noted, a student who follows these procedures and is excused from class for a religious holy day may not be penalized, but the instructor may respond appropriately if the student fails to satisfactorily complete a missed assignment or examination within a reasonable time after the absence. The full policy can be found in HOOP Policy Number 112, Observing Religious Holy Days <http://www.uth.edu/hoop/policy.htm?id=1448072>

Military Obligations: For any academic term that begins after the date a student is released from active military service but not later than the first anniversary of that date, a school shall readmit the student, without requiring reapplication or charging a fee for readmission, if the student is otherwise eligible to register for classes. On readmission of the student under these circumstances, the School shall provide to the student any financial assistance previously provided by the institution to the student before the student's withdrawal if the student meets current eligibility requirements for the assistance, other than any requirement directly affected by the student's service, such as continuous enrollment or another similar timing requirement; and allow the student the same academic status that the student had before the student's withdrawal, including any course credit awarded to the student by the institution. The university may require reasonable proof from a student of the fact and duration of the student's active military service.

Similarly, if a student enrolled in a school fails to attend classes or engage in other required activities because the student is called to active military service that is of a reasonably brief duration and the student chooses not to withdraw from school, the school shall excuse a student from attending classes or engaging in other required activities, including examinations, in order for the student to participate in active military service to which the student is called, including travel associated with the service. A student whose absence is excused under this provision may not be penalized for that absence and shall be allowed to complete an assignment or take an examination from which the student is excused within a reasonable time after the absence. An instructor may appropriately respond if the student fails to satisfactorily complete the assignment or examination with a reasonable time after the absence.

Military Service Withdrawal: A student who withdraws as a result of being called to active military service may choose: (1) to receive a refund of tuition and fees for the semester; (2) if eligible, to be assigned an incomplete “I” in each course; or (3) at the instructor’s discretion, to receive a final grade in the courses where the student has completed a substantial amount of course work and has demonstrated sufficient mastery of the course material.

Sexual Misconduct

Title IX of the Education Amendments of 1972 prohibits discrimination based on sex in educational programs or activities. UTHealth is committed to providing an environment free from discrimination and inappropriate conduct, which includes all forms of sexual misconduct, including sexual harassment and sexual assault. Sexual misconduct will not be tolerated, and individuals who engage in such conduct shall be subject to disciplinary action.

In accordance with this commitment, UTHealth developed a policy specifically to address this important issue as well as training programs as part of UTHealth’s Title IX compliance program to ensure that all members of the university community receive education and understand UTHealth’s policies and procedures. The full policy on sexual misconduct, contact information for UTHealth’s Title IX Coordinator, and how to proceed if you are a victim of sexual misconduct, including sexual harassment and sexual assault, can be found online in HOOP Policy Number 59, Sexual Misconduct <http://www.uth.edu/hoop/policy.htm?id=1447966>.

Equal Opportunity, Discrimination and Harassment

UTHealth has established procedures for dealing with allegations of discrimination and/or harassment on the basis of race, color, religion, sex, sexual orientation, national origin, age, disability or veteran status. Any student who feels subjected to discrimination and/or harassment should use the appropriate process outlined in Hoop Policy Number 183. This policy applies to the conduct of all members of the UTHealth community, including, but not limited to administrators, faculty, staff, students, residents, fellows and other trainees, volunteers, vendors, consultants, observers and visitors. The full policy, can be found online in HOOP Policy Number 183, Equal Opportunity, Discrimination and Harassment <http://www.uth.edu/hoop/policy.htm?id=1448214>

Substance Abuse – Students

UTHealth is committed to maintaining an environment that is free from substance abuse. The university expects impaired students to seek help voluntarily and to assume responsibility for their professional and personal conduct. UTHealth recognizes that substance abuse is a treatable condition and, as an institution dedicated to health, facilitates the treatment and rehabilitation of this condition. Such assistance may be provided through Student Health and Counseling Services, the Medical School Department of Psychiatry and Behavioral Sciences, private physicians or community agencies with expertise in treating chemical dependence.

The full policy on Substance Abuse can be found online in HOOP Policy 173 at <https://www.uth.edu/hoop/policy.htm?id=1448194>

Student Travel

UTHealth supports the educational, research, and service activities of its students by sponsoring and reimbursing certain approved travel activities and expenditures. The university, however, has special concerns as to how students are asked or permitted to travel on official university business. The Student Travel policy ensures that students who are asked or authorized to travel are aware of university rules on travel, how to seek and obtain approval for travel, how to be reimbursed for travel expenditures, and safety rules that apply to student travel.

The full policy on Student Travel can be found online in HOOP Policy 61 at <https://www.uth.edu/hoop/policy.htm?id=1447970>

Solicitation on Campus

No solicitation shall be conducted on the campus of UTHealth unless permitted under HOOP Policy 165. Auxiliary Enterprises is the responsible office at UTHealth for coordinating the review and approval for solicitation on campus. All other inquiries or questions regarding the definitions outlined in the university policy should be directed to the Office of Legal Affairs.

The full policy on Solicitation on Campus can be found online at <https://www.uth.edu/hoop/policy.htm?id=1448178>

Other Important Policies Affecting Students

The Handbook of Operating Procedures (HOOP) lists other important policies affecting students and is divided into a Table of Contents found in the HOOP Disposition Table. Students are charged with knowledge of and compliance with all applicable UTHealth policies .

Some additional important HOOP Policies not outlined in detail above include:

Policy Number:

- 109 General Standards of Conduct
<http://www.uth.edu/hoop/policy.htm?id=1448066>
- 9 Alcoholic Beverages
<http://www.uth.edu/hoop/policy.htm?id=1447866>
- 8 Use of University Name or Logo On Merchandise
<http://www.uth.edu/hoop/policy.htm?id=1447864>
- 11 Use of University Facilities
<http://www.uth.edu/hoop/policy.htm?id=1447870>
- 174 Speech and Assembly
<http://www.uth.edu/hoop/policy.htm?id=1448196>
- 167 Student Employment Appointments
<http://www.uth.edu/hoop/policy.htm?id=1448182>
- 56 Student Financial Aid
<http://www.uth.edu/hoop/policy.htm?id=1447960>

- 121 Student Loan Collections
<http://www.uth.edu/hoop/policy.htm?id=1448090>
- 57 Tuition, and Fees Payment, Refunds and Student Debt
<http://www.uth.edu/hoop/policy.htm?id=1447962>
- 58 Determination of Resident and Non-Resident Tuition Status
<http://www.uth.edu/hoop/policy.htm?id=1447964>
- 60 Student Services
<http://www.uth.edu/hoop/policy.htm?id=1447968>
- 85 University Closure for Emergency, Disaster or Severe Weather
<http://www.uth.edu/hoop/policy.htm?id=1448018>
- 86 Medical Emergencies, Minor Injuries/Illnesses
<http://www.uth.edu/hoop/policy.htm?id=1448020>
- 87 Reporting Criminal Activity on Campus
<http://www.uth.edu/hoop/policy.htm?id=1448022>
- 168 Conduct of Research
<http://www.uth.edu/hoop/policy.htm?id=1448184>
- 202 Honesty in Research
<http://www.uth.edu/hoop/policy.htm?id=1702018>
- 59 Sexual Misconduct
<http://www.uth.edu/hoop/policy.htm?id=1447966>

The University of Texas Health Science Center at Houston

and

The University of Texas MD Anderson Cancer Center

The University of Texas Graduate School of Biomedical Sciences at Houston

2014 – 2016 Catalog



THE UNIVERSITY OF TEXAS
**MD Anderson
Cancer Center**

Making Cancer History®

The University of Texas Health Science Center at Houston (UTHealth) is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) to award certificate, baccalaureate, masters, doctoral, and professional degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of The University of Texas Health Science Center at Houston.

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 doctoral levels. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4501 for questions about the accreditation of The University of Texas MD Anderson Cancer Center.

This catalog is a general information publication only. It is not intended to nor does it contain all regulations that relate to students. Applicants, students, and faculty are referred to the GSBS General Catalog. The provisions of this catalog and/or the GSBS General Catalog do not constitute a contract, expressed or implied, between any applicant, student or faculty member and UTHealth or The University of Texas MD Anderson Cancer Center (MD Anderson) or The University of Texas System. UTHealth and MD Anderson reserve the right to withdraw courses at any time, to change fees or tuition, calendar, curriculum, degree requirements, graduation procedures, and any other requirement affecting students. Changes will become effective whenever the proper authorities so determine and will apply to both prospective students and those students already enrolled. To the extent provided by applicable law, no person shall be excluded from participation in, denied the benefits of, or be subject to discrimination under any program or activity sponsored or conducted by The University of Texas Graduate School of Biomedical Sciences at Houston on the basis of race, color national origin, religion, sex, sexual orientation, age, veteran status, or disability.

MESSAGE FROM THE UNIVERSITY OF TEXAS GRADUATE SCHOOL OF BIOMEDICAL SCIENCES DEANS

Welcome to The University of Texas Graduate School of Biomedical Sciences (GSBS) at Houston.



Michelle C. Barton, PhD

Our school is built around the scientific expertise of two major institutions in the Texas Medical Center, MD Anderson Cancer Center and UTHealth, which are both members of the University of Texas statewide system. In addition, we have faculty participation from Texas A&M Health Science Center Institute for Biosciences and Technology, and our students have access to graduate courses offered at nearby Rice University and Baylor College of Medicine. This breadth offers amazing opportunities in basic and translational scientific programs, leading the way in research and discoveries.

Our vision for the graduate school is 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 have major impact on treatment of diseases worldwide.



Michael R. Blackburn, PhD

Within this catalog you will find valuable information concerning our curriculum, research programs, academic activities and key policies and procedures for our graduate school. In addition, we encourage you to make full use of our website (<http://gsbs.uth.edu/home/index.htm>) where you may access additional information to help you develop your strategy for completing your MS or PhD degrees at our institution.

Now is an incredible time to be training in the biomedical sciences. The technologies and information available today are unprecedented and provide opportunities for outstanding training and the ability to make discoveries that impact humanity. We look forward to partnering with you on your journey to achieve your goals in science and beyond.

Michelle C. Barton, PhD
Dean

Michael R. Blackburn, PhD
Dean

ACADEMIC CALENDAR 2014 - 2015

Fall Term 2014

August 18

New Student Orientation Begins

August 25

Fall Semester Begins

September 1

Labor Day Holiday – no classes

September 15

First Tutorial Begins

November –27-28

Thanksgiving Holiday – no classes

December 12

Last Day of Classes

December 12

First Tutorial Ends

December –15-19

Final Examinations

December 19

End of Fall Semester

Spring Term 2015

January 5

Second Tutorial Begins

January 12

Spring Semester Begins

January 19

MLK Holiday – no classes

February 16

Presidents' Day Holiday – no classes

March 6

Second Tutorial Ends

March 9-13

Spring Break – no classes

March 16

Third Tutorial Begins

May 4

Last Day of Classes

May –5-11

Final Examinations

May 11

End of Spring Semester

May 15

Third Tutorial Ends

May 23

Formal Commencement

Summer Term 2015

May 26

Summer Term Begins

July 4

Holiday – no classes

July 8

Second 6-Week Session Begins

August 17

Last Day of Classes

August 18-19

Final Examinations

August 19

End of Summer Semester

ACADEMIC CALENDAR 2015 - 2016

Fall Term 2015

August 17

August 24

September 7

September 14

November –26-27

December 11

December 11

December 14-18

December 18

New Student Orientation Begins

Fall Semester Begins

Labor Day Holiday – no classes

First Tutorial Begins

Thanksgiving Holiday – no classes

Last Day of Classes

First Tutorial Ends

Final Examinations

End of Fall Semester

Spring Term 2016

January 4

January 11

January 18

February 15

March 4

March 7-11

March 14

April 29

May –2-6

May 6

May 7

May 13

Second Tutorial Begins

Spring Semester Begins

MLK Holiday – no classes

Presidents' Day Holiday – no classes

Second Tutorial Ends

Spring Break – no classes

Third Tutorial Begins

Last Day of Classes

Final Examinations

End of Spring Semester

Formal Commencement

Third Tutorial Ends

Summer Term 2016

May 23

May 30

July 4

July 6

August 12

August –15-16

August 16

Summer Term Begins

Holiday – no classes

Holiday – no classes

Second 6-Week Session Begins

Last Day of Classes

Final Examinations

End of Summer Semester

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R.W. Butcher, PhD

Dean Emeritus

MISSION STATEMENT

The mission of The University of Texas Graduate School of Biomedical Sciences at Houston (GSBS) is to train and educate research scientists and scientist-educators, to generate new knowledge in the biomedical sciences, and to increase public understanding of science.

Our goal 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, UTHealth and other institutions across the Texas Medical Center. 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, UTMDACC, and the Texas A&M Health Science Center Institute of Biosciences and Technology (IBT). As a comprehensive health science university, UTHealth'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 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. UTMDACC'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. IBT's mission is to perform advanced and innovative molecular research in bioscience and medicine and to encourage transfer of new discoveries from the laboratory to the marketplace. The 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.

History and Purpose

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

From its beginnings the School adopted an interdisciplinary approach to biomedical sciences education in contrast to more traditional departmentalized models focused on particular disciplines. The graduate programs of the School offer areas of concentration at the leading edge of education in the biomedical sciences. As a result, the School has attracted large numbers of outstanding faculty and students. School faculty has grown to over 550 members, and currently there are about 480 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 School is an integral and essential part of the academic activities not only of UTHealth but also of the UTMDACC. Together, UTMDACC and UTHealth provide the supporting academic framework for the GSBS. The Texas Education Code stipulates that UTMDACC 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 School is absolutely dependent upon UTHealth and UTMDACC because School 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 and UTMDACC is fundamental and symbiotic.

THE FACULTY

Faculty at the School is drawn from several UTHealth academic units (Medical, Dentistry, Biomedical Informatics, Public Health, and Nursing), from UTMDACC including the Science Park-Research Division at Smithville and Science Park-Veterinary Division in Bastrop, and from IBT.

The research interests of the faculty span the entire range of the biomedical sciences. These areas of interest currently include biochemistry, bioinformatics, biostatistics, cancer biology, cell biology, developmental biology, epigenetics, experimental therapeutics, genetic counseling, genetics, immunology, infectious disease, medical physics, microbiology, molecular biology, neuroscience, pharmacology, physiology, translational research and virology. The School's faculty are listed at the end of this catalog; individual faculty profiles are available on the GSBS website.

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. However, students with specific interests in acquiring technical and specific professional skills may be admitted to courses of study for the MS degree. 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 and non-degree programs offered at the School are described in the following sections.

DOCTOR OF PHILOSOPHY DEGREE IN BIOMEDICAL SCIENCES

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.

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 has developed a challenging six-step curriculum that gives the student the opportunity to attain the skills necessary to pursue a career in biomedical research. The six 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 their 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. Beginning in Fall 2014, most first-year PhD students in the bench sciences will take a one-semester Core Course entitled Foundations of Biomedical Research (GS211017) to satisfy the breadth requirement. The remaining PhD students will take Program-specific courses to meet this requirement. Students matriculating prior to Fall 2014 will meet the breadth requirement by completion of a minimum of four introductory courses in the Quantitative, Molecular, Cellular, and Systems areas of the biomedical sciences or by completion of a different set of courses required by a specific Program of study.
3. *Appreciation of the ethical issues in biomedical research:* Each student is required to demonstrate knowledge in biomedical ethics by passing a one-credit-hour course entitled The Ethical Dimensions of the Biomedical Sciences (GS211051). The course, taught by School faculty, will provide students with a framework to recognize, examine, and resolve ethical conflicts in their professional lives. The course explores such issues as the commitment to truth and its breakdown; the ethics of authorship; experimentation with human and animal subjects; and the relationships of scientists to industry, society at large, and future generations. In addition, two on-line modules, "Data Acquisition and Management" and "Responsible Authorship and Publication" must also be successfully completed by all students.
4. *Science writing ability:* Each student is required to demonstrate knowledge in scientific writing either by passing a one-credit-hour course entitled Science Writing (GS211151) or by passing a Program-specific science writing course.
5. *Capability to formulate a significant research problem:* Each student is given the opportunity to develop the skills needed to formulate a significant research problem in one of the GSBS Areas of Research Concentration approved by the Texas Higher Education Coordinating Board. The attainment of this skill is demonstrated by the student's passing an oral candidacy examination, which tests the student's depth of preparedness for undertaking a research problem and knowledge of the pertinent scientific background.

6. *Ability to perform research that significantly contributes to the scientific body of knowledge:*

The student performs research and 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.

- Prior to the defense, students who matriculated between Fall 2008 and 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 matriculate in Fall 2014 and thereafter must submit at least one first-authored paper 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. A request for exception to these policies must be endorsed by the Advisory Committee and approved by the Academic Standards Committee. All completed dissertations are available to the public.

The six 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 Graduate School of Biomedical Sciences at Houston requires a minimum of 54 credit hours to obtain the degree of Doctor of Philosophy (PhD). Students are required to register as full-time students each term, for a total of 24 credit hours earned each year. The average time to completion of the PhD degree is 5.4 years. Thus, PhD students, on average, complete 135 credit hours by the completion of the degree requirements. The 54 credit-hour minimum includes one credit hour of the *Ethical Dimensions of the Biomedical Sciences* (GS211051), 6 credit hours of Tutorial Research Experience (GS001514), *Foundations of Biomedical Research* (GS211017) or required School area requirement courses, and a minimum of one year of registration for research, which includes *Research in Biomedical Sciences* (GS001520) and *Dissertation for Doctor of Philosophy* (GS001920). 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 54 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 School, at other UT schools, or at an institution with which a consortium arrangement exists (e.g., Rice University, the University of Houston, Baylor College of Medicine, etc.).

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 Associate Dean of Graduate Education if:

1. The student has a Masters degree from another institution, provided the MS degree involved laboratory research and the preparation of a thesis; or
2. The student has had post-baccalaureate laboratory research experience judged to be equivalent to a tutorial rotation; or
3. 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 Associate Dean of Graduate Education. 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 accompanied by a letter from the student's proposed advisor supporting the waiver. Students who are allowed to waive a tutorial requirement on the basis of their GSBS MS degree may not complete a tutorial in that same lab, i.e., they must complete their remaining tutorials in two other labs.

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

Core Course (for PhD Students Matriculating in Fall 2014 and Thereafter)

Beginning in Fall 2014, most PhD students in the bench sciences are required to pass with a grade of at least C (or demonstrate equivalent proficiency) a one-semester Core Course entitled Foundations of Biomedical Research (GS211017). 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 will take Program-specific courses to meet this requirement.

Area Course Requirements (for PhD Students Matriculating Prior to Fall 2014)

All PhD students matriculating prior to Fall 2014 must complete with a grade of at least C (or demonstrate equivalent proficiency as determined by the Academic Standards Committee) one course from each of the following four Areas: Quantitative, Molecular, Cellular, and Systems.

The only exception is made for students who are affiliated formally with a Program that has been approved by School Faculty to have modified area requirements. Currently, five Programs have modified area requirements: Biochemistry and Molecular Biology; Genes and Development; Medical Physics; Biostatistics, Bioinformatics and Systems Biology; and Microbiology and Molecular Genetics. Students affiliated with one of these Programs are required to meet the specific course requirements of that Program.

The Core Course or Area courses must be completed before the student petitions to take the PhD candidacy examination. These courses are intended to provide students with breadth of knowledge in relevant areas of biomedical sciences and provide enhanced communication skills. The objective of the requirement for breadth in education is to facilitate creative collaboration between biomedical scientists trained in depth in different disciplines.

A description of the Core Course and listings of the approved Area courses are posted on the GSBS website and are available in the Office of Academic Affairs.

Recognition of Previous Graduate Course Work for GSBS Area Courses or the Core Course

Students may petition for approval of a graduate-level course taken at another institution to satisfy one of the four Area requirements or the Core Course requirement by providing documentation that the course is equivalent to a School course that satisfies the requirement. The request to substitute a course should be submitted to the Office of Academic Affairs for approval by the Associate Dean of Graduate Education. Undergraduate-level courses are unacceptable as substitutes for GSBS Area courses or the Core Course.

Ethics Course Requirement

All students are required to pass a one-credit-hour course entitled The Ethical Dimensions of the Biomedical Sciences prior to petitioning for candidacy. The aim of the course, taught by School faculty, is to provide students with a framework to recognize, examine, and resolve ethical conflicts in their professional lives. The course explores such issues as the commitment to truth and its breakdown; the ethics of authorship; experimentation with human and animal subjects; and the relationships of scientists to industry, society at large, and future generations. In addition, two on-line modules, "Data Acquisition and Management" and "Responsible Authorship and Publication" must also be successfully completed by all students.

Science Writing Requirement (for Students Matriculating in Fall 2014 and Thereafter)

All PhD students are required to pass a one-credit-hour course entitled Science Writing (GS211151), or an approved Program-specific science 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 Examination Committee that the student should be permitted to bypass the MS degree will be reviewed by the Academic Standards Committee.

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

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

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 provide an opportunity for interaction between students and faculty who have similar research interests.

PhD students matriculating in Fall 2012 or thereafter are required to affiliate with a Program by the end of their first year of study.

The curricular recommendations developed by the Programs provide sufficient flexibility to permit students to develop an individualized program of study within the Program's framework. At the PhD level, current organized Programs of study include:

Biochemistry and Molecular Biology
Biostatistics, Bioinformatics and Systems Biology
Cancer Biology
Cell and Regulatory Biology
Clinical and Translational Sciences
Experimental Therapeutics
Genes and Development
Human and Molecular Genetics
Immunology
Medical Physics
Microbiology and Molecular Genetics
Molecular Carcinogenesis
Neuroscience
Virology and Gene Therapy

Further information about PhD Programs and the faculty affiliated with them may be obtained from the GSBS website (<http://gsbs.uth.tmc.edu>) or the Office of Academic Affairs.

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 an hypothesis, to design the means by which to test it, and to critically analyze obtained results. The purpose of the oral candidacy examination is to give 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; and
- 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;
- Formulates a research problem, the solution of which will make a substantial contribution to our existing knowledge;
- Makes sound judgments about the proposed experimental design and can interpret critically the results anticipated; and
- 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, science writing (for students who matriculated in Fall 2014 and thereafter) and ethics requirements, and either the Core Course or the Area course requirements.

PhD students must take a candidacy exam in the "off-topic" format or a format specified by their Program. "Off-topic" means that the written proposal must be on a topic different from the student's proposed dissertation project, different from any project pursued by the student in a tutorial rotation, different from the student's MS thesis (if applicable), different from any on-going project in the laboratory of the student's advisor, and not a project that differs in a trivial manner from any of the above (that is, different animal model, different gene, etc.). Individual Programs have further defined off-topic and the Program Directors and Program guidelines should be consulted before a student prepares these abstracts.

PhD Candidacy Examination

All PhD students must prepare and defend a research proposal as part of their candidacy examination. The candidacy examination should take place in the first semester of the third year following matriculation after the petition is approved by the Academic Standards Committee. The candidacy examination tests both breadth and depth of the student's understanding of a defined research area. The examination includes both written and oral components.

It is the student's responsibility to select the date, time, and place of the examination. If a member of the Examining Committee is unable to attend the examination, a substitute who meets the

same criteria (e.g., outside the student's major interest or from another department/Program) should be added. The new member must be approved by the Office of Academic Affairs and the Academic Standards Committee Chair.

Results of the PhD Candidacy Examination

The Chair of the Examining Committee is responsible for submitting the results of the examination to the Office of Academic Affairs for review by the 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 Examination 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) should be submitted to the 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 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; 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 *Dissertation for Doctor of Philosophy* (GS001920). 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"

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 Masters 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

Within three years after advancement to candidacy, and 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 Office of Academic Affairs.

- Prior to the defense, students who matriculated between Fall 2008 and 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 matriculate in Fall 2014 and thereafter must submit at least one first-authored paper 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. A request for exception to these policies must be endorsed by the Advisory Committee and approved by the Academic Standards Committee.

The dissertation defense will be held no sooner than two weeks or later than three months after the request form is received by the Office of Academic Affairs 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 GSBS students and faculty and posted on various bulletin boards throughout the Texas Medical Center.

Guidelines for the defense are:

- The student will deliver a 45- to 60-minute public presentation, 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 defense, 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. Within one week after the dissertation defense, the results of this meeting will be communicated through the 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 School Faculty member 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 School Faculty. In particular cases, the Dean may solicit additional evaluations of the dissertation from experts in the field either within or outside the School Faculty.

The decision of the Dean will be communicated to the student and the Advisory Committee within one month of the dissertation defense.

Completion of the PhD Requirements

The PhD degree is not awarded until: the student has successfully completed the dissertation defense; the unbound dissertation, approved by the Advisory Committee, is submitted to the Office of Academic Affairs for the Dean's signature; the first-authored paper requirement has been met; and all exit forms are completed and submitted to the 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 GSBS Areas of Research Concentration approved by the Texas Higher Education Coordinating Board.

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.

DOCTOR OF MEDICINE/DOCTOR OF PHILOSOPHY DUAL DEGREE PROGRAM

The UTHealth Medical School and Graduate School of Biomedical Sciences, and MD Anderson Cancer Center participate in a combined training program leading to both MD and PhD degrees. This program is sponsored and supported by UTHealth and UTMDACC for the most qualified student candidates. 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 graduate school 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 involves faculty at both institutions.

Students must meet the admissions requirements of the 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 website at <http://mdphd.uth.tmc.edu/index.html>.

Those interested in the MD/PhD Program should inquire through the Admissions Office of the Medical School. 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 application online at <http://mdphd.uth.tmc.edu/applications/html>. 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 1. Interested students may also contact the MD/PhD Program Manager, Jo Cheatwood, at 713.500.6607 or by email at jo.cheatwood@uth.tmc.edu.

MASTER OF SCIENCE DEGREE IN BIOMEDICAL SCIENCES

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. Laboratory studies provide opportunities to gain technical facility with the methods required for investigation. The preparation of the MS thesis provides experience in stating a research problem within the framework of contemporary knowledge, presenting the rationale for the technical approach to be taken in solving the problem, presenting valid and reproducible results obtained by the application of methodology appropriate to the problem, and providing 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 evidence 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 in the solution of a scientific problem. The thesis should be an original document written by the student.

The MS degree remains an important component of the School's educational program. Although many students currently bypass the MS portion of the PhD program, the Faculty 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

The MS program of work must consist of a minimum of 30 credit hours of coursework, which must include one credit hour of The Ethical Dimensions of the Biomedical Sciences plus the two online Ethics modules, at least six credit hours of Thesis for Master of Science and a minimum of six credit hours of Research in Biomedical Sciences. A minimum of 12 credit hours of didactic courses, graded A/F, must be taken. Other didactic courses, Literature Survey, Special Project: Course, and Special Project: Research may be used toward the remaining required credit hours. The majority (i.e., over 50%) of these 30 credit hours, plus the majority of any additional coursework required by the Academic Standards Committee or the student's Advisory Committees, must be taken in residence at GSBS, at other UT schools, or at an institution with which UTHealth has consortium arrangements (e.g., Rice University, the University of Houston, Baylor College of Medicine, etc.).

Students in an MS degree program who have completed graduate courses in the general area of biomedical sciences at another institution may request that credit hours earned elsewhere be used toward the 30-credit hour GSBS requirement. While there is no limit to the number of hours for which a student may be credited, no more than two courses may be used toward the GSBS minimum requirement of 30 credit hours. The student must have received at least a C (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 such courses taken at other institutions will not be used in the calculation of the cumulative grade point average.

The following rules apply to registration for *Special Project: Course*, *Special Project: Research*, and *Literature Survey*:

- *Special Projects* should not exceed four hours per semester and Literature Surveys should not exceed two hours per semester.
- No more than 6 credit hours of *Special Project (or Tutorial Research Experience)* plus *Literature Survey* may be accepted toward meeting the 30 credit hours required for completion of the MS degree.
- If more than one *Special Project: Research* is included in the MS program of work, the projects must be supervised by different instructors.
- Degree students will not be permitted to use credit hours in *Special Project: Research* taken while they were non-degree students toward meeting the 30 credit hours required for completion of the MS degree.

Ethics Course Requirement

All students are required to pass a one credit hour course entitled The Ethical Dimensions of the Biomedical Sciences. The aim of the course, taught by School Faculty, is to provide students with a framework to recognize, examine, and resolve ethical conflicts in their professional lives. The course explores such issues as the commitment to truth and its breakdown, the ethics of authorship, experimentation with human and animal subjects, and the relationships of scientists to industry, society at large, and future generations. This course, 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, an abstract of the proposed research, and the proposed members of the Advisory Committee. The program of work should indicate the courses that will be used to fulfill the minimum 30 semester credits for the MS; for purposes of the petition to candidacy this may include courses taken, in progress, and/or planned. The petition must be approved by the Academic Standards Committee and the student admitted to candidacy before the student can receive credit for the first semester of Thesis. The petition should be submitted within one year of admission to the MS program or within two years of admission to the PhD program, or for M.D./PhD students, after the first full year of enrollment in the School. 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. The form, with a one-page summary of the research, should be submitted to the Office of Academic Affairs at least 14 days before the scheduled thesis defense. The Office of Academic Affairs checks 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 distributed by electronic mail to GSBS students and faculty and is posted on appropriate bulletin boards throughout the Texas Medical Center. If the program has not been completed, the student and the Committee are notified and the thesis defense will not be permitted until the required courses have been completed.

Completion of the MS Requirements

The MS degree is not issued until the student has successfully completed the defense; the unbound thesis, approved by the Advisory Committee, is submitted to the Office of Academic Affairs for the Dean's signature; all grades are received; and all exit forms are completed and submitted to the Office of Academic Affairs. The MS degree is 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 first registration in GSBS. Students may continue registration in GSBS after the three-year limit only with the express written permission of the Dean. Students admitted to the School for the express purpose of obtaining only an MS degree and who wish to work for a PhD must reapply for admission to a 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

Qualified students may be admitted to the School to pursue an MS degree with a concentration in Biomedical Sciences, or in a Program, upon approval by the Program Director. With the advice and consent of an advisory committee, the student will construct a plan of study, including didactic course work and a thesis topic appropriate to his or her particular interests. The degree can usually be completed in two years of full-time study, although the School permits students three years for completion of degree requirements.

SPECIALIZED MS DEGREE PROGRAMS: GENETIC COUNSELING

The specialized Master of Science degree in Genetic Counseling is designed for individuals who seek a terminal MS degree with requisite education in human genetics and genetic counseling skills. The program's objective is to provide clinical and research training in genetic counseling, with graduating students demonstrating proficiency in genetic counseling competencies and having accrued a substantial and diverse clinical case experience in order to sit for the American Board of Genetic Counseling credentialing exam. The program's challenging curriculum provides comprehensive training in medical genetics and genomics, cancer genetics, prenatal genetics, psychosocial counseling, and genetic counseling research. Students receive an in-depth exposure to a variety of genetics clinics. In addition to the general MS requirements, the Genetic Counseling Program requirements include the successful completion of specialized courses, clinical rotations and a masters of science thesis.

Curriculum

Genetic Counseling students take classes in the areas of cancer genetics, prenatal genetics, and medical genetics, research methodology, developmental biology, and ethics, as well as psychosocial counseling. The majority of course work is completed by the end of the first year. Clinical rotations and the completion of a masters research thesis project dominate the second year. Required course work includes (credit hours in parentheses):

Introduction to Genetic Counseling (2)

Developmental Anatomy (2)

Topics in Medical Genetics I (2)
Topics in Medical Genetics II (2)
Approaches to Research in Genetic Counseling I (2)
Approaches to Research in Genetic Counseling II (2)
Psychosocial Issues in Genetics (2)
Psychosocial Genetics Practicum (1) x24
The Ethical Dimensions of the Biomedical Sciences (1)
Cancer Genetic Counseling (2)
Prenatal Genetic Counseling (1)
Contemporary Issues in Genetic Counseling (1) x2
Introductory Clinical Rotations (3)
Advanced Clinical Rotations (4) x3
Masters Thesis Research (4) x2

MS Thesis

Students are expected to propose and complete a laboratory or clinically-oriented research question that will include study design, collection of data (where applicable), data analysis, and a written thesis. A written thesis and oral defense of the thesis is required for graduation.

Clinical Rotations

Clinical experience is an essential aspect of genetic counseling training. Students at UTHealth receive cases of significant depth and breadth in the genetic counseling arena. Typically, students amass over 200 clinical cases, well above the minimum standard of 50 cases needed to complete a logbook that allows a student 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.

Prerequisites

Admissions requirements are those established by GSBS for the MS program. A Subject Test of the GRE is recommended, but not required. A cumulative undergraduate GPA of 3.0 or greater is required. Successful applicants generally have a GPA of 3.5 or better, and GRE scores in the 75% range. However, the Genetic Counseling Program considers the entire application when selecting applicants to interview.

The following background is strongly recommended:

- Client advocacy experience (crisis counseling/Planned Parenthood)
- Volunteer experience
- Genetic counseling internship/shadowing/exposure
- Undergraduate or graduate coursework in
 - Biology
 - Psychology
 - Genetics
 - Chemistry
 - Biochemistry
 - Calculus
 - Statistics

An interview at the School is required for admission to the Program. On average, the Program receives 80-100 applications each year and interviews approximately 35 candidates. Offers to interview are extended in early March after the applications are reviewed.

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
The University of Texas Medical School at Houston
P.O. Box 20708
Houston, Texas 77225
Claire.N.Singletary@uth.tmc.edu

SPECIALIZED MS DEGREE PROGRAMS: MEDICAL PHYSICS

The Specialized Master of Science in Medical Physics Program prepares students for a clinically-oriented career in medical physics 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's requirements entail coursework, thesis research and clinical rotations.

Coursework

1. The student must complete a minimum of 32 hours of required courses.

Required Courses (semester hours in parentheses)

Mathematics for Medical Physics (3)
Introduction to Medical Physics I: Basic Interactions (3)
Introduction to Medical Physics II: Medical Imaging (3)
Introduction to Medical Physics III: Therapy (3)
Introduction to Medical Physics IV: Nuclear Medicine (3)
Electronics for Medical Physicists (3)
Radiation Detection, Instrumentation, and Data Analysis (3)
Radiation Biology (2)
Introduction to Radiation Protection (3)
Anatomy and Oncology for Medical Physicists (2)
Medical Physics Seminar (3 semesters x 1 hour / semester; 3)
The Ethical Dimensions of the Biomedical Sciences (1)

2. The student must complete a minimum of two hours of electives.

Available Electives (semester hours in parenthesis)

Principles of Magnetic Resonance Imaging (2)
Physics of Positron Emission Tomography (2)
Special Radiation Treatment Procedures (2)
Fundamental Biological Principles of Molecular Imaging & Therapeutics (4)
Various Medical Physics Special Project Courses (2 each)
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, by the Program and the GSBS Academic Standards 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 written version is signed 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.

Clinical Rotations

The student must complete two clinical rotations of 200-300 contact hours' duration each:

- Radiation Therapy Physics Rotation (4)
- Diagnostic Imaging Physics Rotation (4)

Optional Supplementary Training

SMS students may receive additional, supplementary training by taking short courses in Therapeutic Radiological Physics offered by the MDACC Department of Radiation Physics, or Imaging Physics offered by the MDACC Department of Imaging Physics. Formal credit is not awarded for these courses and they are not required for graduation. Students may enroll through the Program Manager for Education, MDACC Department of Imaging Physics.

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 General Test of the Graduate Record Examinations is required; the specialty test in physics is optional, but could be of benefit to the applicant. 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:

Richard E. Wendt III, PhD
Director, Graduate Program in Medical Physics
The University of Texas MD Anderson Cancer Center
Department of Imaging Physics, Unit 1352

PO Box 301439
Houston, Texas 77230-1439
rwendt@mdanderson.org

NON-DEGREE STUDY

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 School 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 School-based or sponsored financial aid, but may be eligible for other types of financial aid from UTHHealth. Further information about non-degree study is included in the section on admission.

RESOURCES FOR GRADUATE EDUCATION

By virtue of its location in the Texas Medical Center and the excellence of its distinguished faculty, the School affords qualified students extraordinary opportunities for basic and clinical research. Didactic teaching and training activities are conducted in lecture rooms and laboratories of component UT institutions where faculty members hold their primary academic appointments. In addition to the resources available within UT institutions, cooperative arrangements with Baylor College of Medicine, Rice University, Texas Woman's University, the University of Houston and the Gulf Coast Consortium provide GSBS students excellent opportunities for developing educational and research programs appropriate to their academic backgrounds and future career interests.

Excellent library facilities are available to provide resource material for course work and research. Students have access to the Houston Academy of Medicine-Texas Medical Center Library (see general information) as well as the specialized GSBS, School of Dentistry, School of Public Health, and MDACC libraries. The Houston Public Library, Rice University (Fondren) Library, University of Houston MD Anderson Memorial Library, and numerous private library facilities also are available for use.

GSBS students have access to a wide range of computing hardware, from laptops to supercomputers, and to a vast array of computer software and services. Within the School itself is a computing facility that includes a variety of desktop computers and printers. The Information Technology Access fee gives students remote access to the Internet and electronic resources of the University, subject to all UTHHealth policies governing such access. The TMC Library provides access to approximately 8,000 online journals, 16,000 e-books and 300 databases, supporting the Texas Medical Center's academic institutions in particular, including the academic and research programs of GSBS. Students may connect to the library at <http://www.library.tmc.edu> to register for free online access accounts. Access to computing systems in the Texas Medical Center and to the UT System supercomputer at Austin is provided via the Internet.

ADMISSION

Admissions Statement

The mission of The University of Texas Graduate School of Biomedical Sciences at Houston (GSBS) is to train and educate research scientists and scientist-educators, to generate new knowledge in the biomedical sciences and to increase public understanding of the biomedical sciences. To prepare students to meet these goals, the GSBS has identified a cohort of faculty and staff who are dedicated to this mission and prepared to meet these commitments to serve the State of Texas and the nation.

The GSBS strives for diversity in the student population to enrich the overall educational experience of the students. All applicants will be evaluated individually, based upon their overall merits; race and ethnicity will be considered as only one of the many criteria utilized in the evaluation. All faculty and staff involved in the evaluation of students for admission are informed of these criteria.

Applicants for the PhD Degree Program

Applicants must have a bachelor's degree or its equivalent from an accredited institution. Applicants are required to have a solid background in the basic sciences. It is recommended that this background include:

Biology - a minimum of two semesters (including a course in introductory biology)

Biochemistry - a minimum of one semester (with prerequisite organic chemistry)

Calculus - a minimum of one semester

Physics - a minimum of two semesters

The applicant should review the website of the Program in which he/she has an interest for a listing of the undergraduate coursework recommended by the Program. The Admissions Committee will examine an applicant's educational history in order to ascertain the applicant's preparation for entry into graduate school. An MS degree is not required for admission to the PhD program. Once an admitted student forms an approved Advisory Committee, this Committee will review the student's undergraduate coursework, and, upon consideration of the student's research focus, make recommendations for any remedial work that would facilitate the successful completion of the dissertation research.

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 recommended coursework listed above). The average undergraduate GPA of students entering the PhD program in recent years has been 3.4

Applicants are required to take the General Test of the Graduate Record Examinations. A Subject Test is not required, but is strongly encouraged. The average GRE score (Verbal + Quantitative scores) of students entering the PhD program in recent years has been 319; this score is for the GRE exam for applicants entering GSBS in Fall 2013.

A student who is initially admitted to the GSBS MS degree program may not submit an application to the PhD degree program prior to the completion of most or all of the research required for the M.S degree. A student in a GSBS MS program may not matriculate into a GSBS PhD program until the MS degree has been awarded.

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. In this case, the applicant is expected to complete a new application for admission and supply any additional materials to update their application.

Applicants for the MS Degree Program

Applicants for MS degree programs will be evaluated for academic qualification as evidenced by academic record, letters of recommendation and GRE results. Students enrolling in MS programs in recent years have had an average GRE score (Verbal + Quantitative) of 316, and an average undergraduate GPA of 3.4.

Factors Considered in Admissions Decisions and Financial Assistance

The School's Admissions Committee may consider the following factors in evaluating applicants for admission and financial assistance:

- Previous research experience and accomplishments, including participation in science fairs, enrollment in laboratory and research-based courses, and involvement in research projects, presentations of research findings and publications;
- Expressed commitment to a career involving biomedical research;
- 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;
- Honors and awards for academic achievement;
- Performance on the Graduate Record Examination and GRE Subject Test (and for international applicants, the Test of English as a Foreign Language (TOEFL)).
- Success in overcoming socio-economic and educational disadvantages;
- Multilingual proficiency;
- Region of residence;
- Non-academic responsibilities, such as employment and child-rearing;
- Involvement in community activities; and
- Race and/or ethnicity.

Application Procedures

Applications must be submitted electronically through: <https://apply.embark.com/Grad/UTHealth/GSBS/>. Applications are reviewed for the Fall semester only.

All components of the application must be submitted electronically for both domestic and international applicants. 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.

Application form Applicants will create an account at: <https://apply.embark.com/Grad/UTHealth/GSBS/> to apply.

- **Unofficial transcripts** - An unofficial copy of the transcript from each college and university attended is required.
- **GRE scores** – GRE scores must be available at the time of application. The applicant will upload a copy of the ETS score report. Scores must be from an exam taken within the last 5 years.
- **TOEFL scores** (International applicants) – The applicant will upload a copy of the ETS score report.
- **Application fee** - A \$30 application fee is required.
- **CV/Resume** - A CV or resume is required and should include academic honors, awards received in college, employment history, internships, summer research programs, education history, etc.
- **Personal statement** - The personal statement should be 1-2 pages 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 GSBS.
- **Presentation and publications listing with abstracts** – List of all publications. List the full citation giving the abstract for each in chronological order. For presentations (poster and oral presentations), indicate the type of presentation, the forum in which the presentation was made, the date of the presentation and the abstract.
- **Optional Essay** - A brief statement detailing any disadvantages (e.g., socioeconomic, educational) the applicant has overcome.
- **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 and personality; contact information must also be provided. If the applicant is currently enrolled, or has completed a graduate program, one of the recommendations must be from the applicant's academic advisor or mentor.

Personal interviews may be requested by the School's Admissions Committee and all admitted applicants must be interviewed by GSBS faculty. Final admission requires receipt of official transcript and ETS score report documents, and is contingent upon a satisfactory completion of the criminal background check.

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 masters degree from a U.S. school will submit the same application described above, but will apply as an international candidate.

The Test of English as a Foreign Language (TOEFL) is administered in foreign countries by the Educational Testing Service and used as a measure of the applicant's level of proficiency in English at the time of application. These tests are required of all foreign nationals whose native language is not English and who have not attended an English-speaking university.

All international students who are admitted to the Graduate School and who do not have a degree from an English-speaking institution will be required to take a diagnostic English language skills test administered in 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 that demonstrate English skills thought to be inadequate for successful performance in GSBS will be required to take and pass an English language skills course during the first year at GSBS. This course will be specified by GSBS.

Application Deadlines

Complete applications, containing all application materials, must be submitted by December 15. Applicants are encouraged to apply by November 1.

Essential Skills for Biomedical Scientists

To be successful as biomedical scientists, individuals must possess necessary cognitive, motor, and sensory skills. These include cognitive abilities in creative problem-solving, quantitative methods, and the objective analysis and interpretation of data. Additionally, biomedical scientists normally require fine motor dexterity, physical strength, and coordination. In order to observe and report biological phenomena effectively, scientists must possess sufficient vision and hearing and must be able to effectively write, speak and comprehend English.

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 School, 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 Office of the Registrar for specific details.

Non-Degree Students

Application to be a non-degree student requires submission of an application form, a statement of intention including a proposed course of study, official transcript(s), and three letters of recommendation. The deadline to apply as a non-degree student is two months prior to the start of the semester.

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 one GSBS course during each semester. Registration forms for this purpose are available from the 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 PhD 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 one GSBS course during each semester. The employee may register for up to two courses with permission of the Dean. If the employee is eventually admitted to the School, 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.

One of the courses an employee may take is a laboratory research tutorial. To do so, the employee must register for the GSBS course entitled *Special Project: Research* (GS001530). This course must simulate, in its requirements, the GSBS course entitled *Tutorial Research Experience* (GS001514), i.e., it should represent a real learning experience in the laboratory of a GSBS faculty member (and not the activity of a laboratory technician). A minimum of 200 hours of effort are required for the two-credit hour tutorial/Special Project, generally a minimum of 20 hours per week. Employees do not need to complete their didactic coursework before registering for *Special Project: Research* (GS001530).

If the employee is admitted to a GSBS PhD program, one of these tutorial-like *Special Projects* may be used to fulfill one tutorial requirement of the PhD degree. Each of the three tutorial rotations required for the PhD must be performed under the guidance of a different GSBS faculty member, and at least one tutorial must be conducted while the student is registered full-time in the PhD program. However, one of the three required tutorials may be waived by the Associate Dean of Graduate Education if the student enters GSBS with an MS degree that involved laboratory-based research and a thesis, or with other appropriate research experience, such as experience resulting in publications.

Upon admission to the PhD program, the employee must become a full-time graduate student. The student's financial support will be in the form of a Graduate Research Assistantship at the standard GSBS level (currently \$29,000 per annum). The admitted student is eligible for GSBS-sponsored financial support for the first two years of PhD graduate study.

FINANCIAL SUPPORT

It is the expectation of the GSBS that each student in the PhD program be supported by a graduate research assistantship (GRA) or by a fellowship/traineeship. As a rule, the GRA is funded by the Graduate School during the first two years of full time and continuous enrollment in the PhD program. Commencing with the third year of study, the graduate mentor is responsible for supporting the GRA. Exceptions to this rule occur when a student is admitted to GSBS with funding through another mechanism (i.e., supported by a program or faculty member). In these few exceptions, once the initial funding mechanism ends, support of the GRA transfers to the student's faculty advisor. The award of a GRA includes:

- A stipend of \$29,000 per annum;
- Payment of the student's GSBS tuition and required fees; and
- Health insurance

Stipends awarded to GSBS students are intended to assist in meeting educational and living costs so that students can devote full time to their studies. It is the expectation of the School that PhD students holding a GRA will not undertake activities, including employment of any kind (beyond the types of financial support employment described in this section) that will interfere with their educational program or delay their progress toward the degree. An exception to this policy will be made by the Dean only if the activity proposed by the student can be justified as contributing in some fashion to the student's training as a researcher/teacher.

No PhD student may hold more than one training position at a time. That is, PhD students hold the Graduate Research Assistant (GRA) training position during their tenure as graduate students, and may not hold other training positions (e.g., post-doctoral fellow) concurrently with the GRA position.

Students who are awarded approved, competitive, external Fellowships are eligible, at their advisor's discretion, to be supplemented up to 130% of the standard GSBS graduate research assistantship. To qualify, the fellowship must be made explicitly under the student's name.

Graduate School assistantships normally are not awarded to students in the individualized or specialized MS degree programs, although financial aid may be available from individual faculty members or the specialized MS programs. Students in MS programs are eligible to receive a stipend (not to exceed the current GRA level) for the duration of their degree training. MS students who do not receive Graduate Research Assistant stipends 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 employment may not be included in the MS thesis.

All degree students may be eligible for the many endowed scholarships and fellowships that are administered by the Deans' Office. The scholarships and fellowships are awarded on a competitive basis by the 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. 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 Office of Academic Affairs.

The School maintains a list of active institutional training grants and can assist students in preparing applications for external fellowships and awards. More information can be found on

the GSBS website under the Training Grant Navigator Program.

In addition to the types of financial aid mentioned above, other sources of support are available through UTHealth's Office of Student Financial Services (see General Information Catalog).

FEES AND EXPENSES

Tuition and fees will be paid for all students who qualify as Graduate Research Assistants. Those student GRAs who receive financial support from the School during their first two years will have their tuition and fees paid by the School. Student GRAs who receive financial support from faculty advisors will have their tuition and fees paid by their faculty advisors.

Tuition for Fall and Spring Semesters

Texas law provides for exemption from or the waiver of tuition and/or fees for students under certain conditions. For specific information, contact the Office of the Registrar. Under Texas law, UTHealth may charge a resident doctoral student who has in excess of 100 credit hours tuition at the rate charged non-resident doctoral students. For specific information, contact the Office of the Registrar.

In 2014-15, resident tuition is \$138 per semester credit hour. Non-resident tuition is \$500 per semester credit hour. In 2015-16, resident tuition is \$182 per semester credit hour; non-resident is \$500 per semester credit hour. Fees are dictated by the University of Texas System and are not mandated by the Legislature. Tuition for residents is at a semester credit hour rate without a minimum.

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

Tuition for Summer Sessions

In 2014-15, resident tuition is \$138 per semester credit hour. In 2015-16, resident tuition is \$182 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

Student fees are authorized by state statute; however, specific fee amounts and the determination to increase fees are made by UTHealth administration and The University of Texas System Board of Regents. Please see the website of the Office of the Registrar at <http://registrar.uth.tmc.edu/> for information on fees.

GENERAL REGULATIONS

Following is a summary of general School regulations. Complete and specific regulations and requirements are included in the School's Policies and Procedures 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 School Catalog and the UTHealth General

Information Catalog (hard copy or webversion) and GSBS Policies and Procedures in effect at the time the student is admitted to a GSBS degree program. However, the student may choose to be guided by the provisions of the Catalog and GSBS Policies and Procedures of any subsequent year in which he or she is in residence.

Degree Requirements

The general requirements for the PhD and MS degrees are described in previous sections of this Catalog. The specific requirements for the degrees and the timetable for meeting the requirements are presented in the School Policies and Procedures.

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 School will appear on a student's GSBS transcript. However, a student may include courses taken elsewhere in the Program of Work he or she prepares in the petition for admission to candidacy for the MS degree. If these courses (a maximum of two) are approved by the student's Advisory Committee and the Academic Standards Committee, the credits earned in these courses may count toward the 30-credit-hour minimum required for the degree. At the PhD level, particular courses taken at the graduate level at another institution, if approved by the Academic Standards Committee, may be considered as meeting individual PhD area 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 School Catalog are assigned grades of Pass (P) or Fail (F). 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.

The symbol "I" (Incomplete) is reported when the student has not completed all the assignments in a course before its conclusion, and is valid for one semester. Before the end of the semester following receipt of the "I" designation, the student must turn in the required work for a regular grade, or the "Incomplete" will be replaced with a failing grade. In unusual circumstances, the student may apply through the instructor for an extension of the "I" period until the next time the course is offered. Incompletes are not normally granted on the basis of poor academic performance.

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 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 course taken while a student at GSBS is grounds for dismissal from 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 may not retake courses in which they received a B 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 differential treatment or mistake. If the evidence warrants 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 of the following actions or conditions can cause the student to be placed on academic probation by the Dean:

Failure of any course;

Failure to maintain a School cumulative grade point average of 3.0 or better;

Failure to meet with his or her 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 School; or,

Failure to make satisfactory progress toward the degree.

Consequences — Any student on probation will not be allowed to stand for the MS final oral thesis examination, petition for the PhD candidacy examination, or stand for the defense of the PhD dissertation.

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 Graduate School:

1. If the student fails any course; or
2. If the student's academic deficiencies are not resolved within the time period specified in policy or by the Dean; or
3. 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); or
4. If the student fails the PhD candidacy examination.

Procedures – The 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 Academic Standards Committee and render a decision on the appeal. The Dean's decision is final.

Student Conduct and Discipline

Students are responsible for knowledge of and compliance with University policies concerning student conduct and discipline as set forth in UTHHealth HOOP Policy 186, Student Conduct and Discipline. The GSBS Code of Conduct pledge must be signed by all students in School degree programs when they first enroll in GSBS and when they petition for MS and 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 School, but may work at outside employment. Students may request an official LOA from the Office of Academic Affairs. Students must state 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 may return prior to the date indicated on the LOA form. Students returning from LOA do not need to re-apply for admission, but they must notify the Office of Academic Affairs that they are returning at least three weeks prior to the semester in which they wish to re-enroll. Extensions of the official LOA for a maximum of up to one additional year may be requested through the Office of Academic Affairs, and must have the approval of the Dean. Requests for extensions must be submitted at least six weeks before the end of the initial leave.

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 the School. Once having withdrawn, a student who wishes to continue formal studies must apply and be readmitted to the School.

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 and MDACC 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., and the policy of the institution at which the student is employed shall apply. In all cases, however, the student should remember that he/she is 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.

GRADUATE STUDENT ASSOCIATION

The GSBS Graduate Student Association (GSA) has as its purposes to provide a student forum for discussion of common needs, to work cooperatively with the faculty and administration to build a recognized and respected institution, and to develop student fellowship and social activities.

The GSA has a responsible position in the operation and development of the School, and it performs an important function as the official organization representing the School's student body. Students recommended by the GSA serve on some of the GSBS standing committees.

OUTREACH PROGRAM

Many GSBS students participate in community service activities organized by the GSBS Outreach Program. Some of the services have included presentation of lectures for science classes and clubs, provision of judges for science fairs, and development of a science project handbook to assist in preparation for science fairs. The Outreach Program not only provides the community with the opportunity to utilize important resources of GSBS, MD Anderson and UTHealth, but also provides our students with a unique opportunity to encourage young students to pursue an interest in science. GSBS has adopted two Houston inner-city elementary schools to support and promote science in a long-term relationship through activities that include "hands-on" science experiments, development of a science laboratory, promotion of science careers through role models, and tours of MD Anderson and UTHealth schools and laboratories.

COURSE OFFERINGS OF THE GENERAL FACULTY

GS00 1020 Practicum in Teaching. Variable credit

All semesters annually. Prerequisite: none. Mattox, William. This course is for the GSBS student who is appointed as a teaching assistant through the GSBS and provides for the student a record of that appointment.

GS00 1514 Tutorial Research Experience. 2 sem. hrs.

Graduate Faculty. All semesters, annually. Enrollment is required of all Ph.D. students during the first two semesters of residence. Not open to M.S. or non-degree students. Students will participate in research laboratories of the GSBS faculty for an equivalent of five afternoons per week (200 total hours) throughout the semester. Students in consultation with their faculty advisors will select the research areas that best support their educational programs. Students spend ten weeks in each of three laboratories, and at least one of the sessions should be in a laboratory outside their major area of specialization.

GS00 1520 Research in Biomedical Sciences. Variable credit

Graduate Faculty. All semesters, annually. Primarily intended for M.S. and Ph.D. students who have selected their advisors and thesis projects.

**GS00 1530 Special Project: Research. Variable credit
Maximum of 4 sem. hrs.**

Graduate Faculty. Maximum of 4 sem. hrs. All semesters, annually. Short-term research project intended to expose students to a research area or set of laboratory techniques. May be used by M.S. or non-degree students to obtain the equivalent of a Tutorial Research Experience.

GS00 1610 Special Project: Course. Variable credit

Graduate Faculty. All semesters, annually. For courses not listed in the GSBS Catalog or courses presented in a different format from that listed in the Catalog.

**GS00 1620 Literature Survey. Variable credit
Maximum of 2 sem. hrs.**

Graduate Faculty. All semesters, annually.

GS00 1910 Thesis for Master of Science. Variable credit

Graduate Faculty. All semesters, annually. For students who have successfully petitioned for M.S. candidacy. Enrollment for a minimum of one semester required for M.S. degree.

GS00 1920 Dissertation for Doctor of Philosophy. Variable credit

Graduate Faculty. All semesters, annually. For students who have passed the Ph.D. oral candidacy examination. Enrollment for a minimum of one semester required for Ph.D. degree.

COURSE OFFERINGS IN BIOSTATISTICS, BIOINFORMATICS AND SYSTEMS BIOLOGY

GS01 1013 Bayesian Data Analysis.

3 sem. hrs.

Fall, annually. Prerequisite: Calculus, linear algebra, prior probability and statistics course (or permission of instructor). Baladandayuthapani, Veera. This course will cover Bayesian methods for analyzing data. The emphasis will be on applied data analysis rather than theoretical development. A variety of models, including linear regression, hierarchical models, and models for categorical data will be considered.

GS01 1023 Survival Analysis.

3 sem. hrs.

Spring, odd-numbered years. Prerequisite: GS011033, Introduction to Biostatistics and Bioinformatics, or permission of instructor. Huang, Xuelin. 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 model, additive risk model, other alternative modeling techniques, and new theoretical and methodological advances in survival analysis will be discussed.

GS01 1033 Introduction to Biostatistics and Bioinformatics.

3 sem. hrs.

Spring, annually. Prerequisite: Calculus and linear algebra. Hess, Kenneth. 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.

GS01 1053 Linear Regression and Statistical Computing.

3 sem. hrs.

Fall, annually. Prerequisite: Introductory statistics, or permission of instructor. Shete, Sanjay. This course will cover basic linear regression analysis. Topics to be covered include simple and multiple regression, diagnostics, influence, and model construction. The emphasis will be on the practical aspects of the construction and validation of linear models. The course will include extensive samples of the use of computer software to perform such analyses. Statistical package "R" will be used primarily for these examples, although other packages will be illustrated as well. (Students will be permitted to use whatever software they prefer for

class assignments.) This course is intended as an applied introduction to regression analysis. Theoretical results will be developed and presented as necessary, but the emphasis will be on applications.

GS01 1062 Introduction to Bioinformatics. 2 sem. hrs.

Fall, annually. Prerequisite: None. Chen, Ken; Navin, Nicholas and Rao, Arvind. 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.

GS01 1083 Mathematical Statistics I. 3 sem. hrs.

Spring, annually. Prerequisite: Advanced undergraduate course in probability and statistics; probability theory and the central concepts and methods of statistics. Yuan, Ying. The course will include a review of probability theory, including generating functions, common families of distributions, multivariate distributions, and hierarchical modeling. Foundations of statistical inference, including sampling distributions, principles of data reduction, maximum likelihood methods, point and interval estimation, hypothesis testing, and decision theory, as well as applications to advanced statistical problem sets, will be discussed.

GS01 1093 Mathematical Probability I. 3 sem. hrs.

Fall, annually. Prerequisite: Calculus, real analysis, or permission of the instructor. Shete, Sanjay. This course is the first of a two-semester sequence covering advanced concepts in mathematical probability. Students will have the opportunity to learn the measure-theoretic foundations of probability. Topics covered include sigma-fields, probability spaces, random variables, measures, measurable functions, expectation, integration, convergence theorems, product spaces, Fubini's theorem, and convergence concepts.

GS01 1113 Introduction to Mathematical Statistics. 3 sem. hrs.

Spring, annually. Prerequisite: Introduction to Mathematical Probability (GS011213), or permission of instructor. Shete, Sanjay. This course is the second of two courses intended to establish a theoretical foundation for the biostatistics and biomathematics curriculum. The material introduced in this course is a necessary prerequisite for GSBS courses in informatics, survival analysis, and advanced Bayesian inference. The focus will be on integrating both classical and Bayesian methods in a comprehensive but elementary survey. This course will discuss the general approach to statistical inference for data arising from an unknown probability distribution. Students will learn methods for characterizing specific properties of the distributions and use them in making future predictions. The course will discuss statistical inferential methods for data arising from continuous or discrete distributions.

GS01 1131 Introduction to Biomedical Statistics and Informatics Core Module. 1 sem. hr.

Fall 2014 Prerequisite: None, but permission from the GSBS Office of Academic Affairs is required. Available only to students who have not yet completed the GSBS quantitative area requirement and are not enrolled in Foundations of Biomedical Research. Schumacher, Jill. This course will provide a practical introduction on how statistical approaches are applied in both

experimental design and in the critical evaluation of data acquired in the biomedical sciences including genetics, genomics, molecular and cellular biology, biochemistry and physiology. This course fulfills the GSBS Quantitative area breadth requirement.

GS01 1133 Statistical Methods in Bioinformatics. 3 sem. hrs.

Fall, annually. Prerequisite: Introduction to Mathematical Statistics (GS011113) or consent of instructor. Liu, Yin. The objective of this course is to introduce students to the concepts and statistical methods for analyzing large-scale biological data generated from emerging genomic and proteomic techniques. The course will focus on the integration of two disciplines - biology and statistics - by first describing statistical methods most often used in the field of bioinformatics and then discussing their applications on the computational analysis of gene sequence, expression and biological interactions at a large scale. The statistical methods covered include dynamic programming, maximum likelihood estimation, Bayesian inference, Hidden Markov Models, Markov chain Monte Carlo, classification and clustering methods. The students will master advanced applications of statistical computing in a wide range of biological and biomedical problems, including multiple sequence alignment, biomarker and disease gene identification, inference of protein interaction network, functional modules and signal transduction networks.

GS01 1143 Introduction to Bioinformatics. 3 sem. hrs.

Fall, annually. Prerequisite: None. Chen, Ken; Navin, Nicholas and Rao, Arvind. 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. This course fulfills the GSBS Quantitative area requirement.

GS01 1153 Longitudinal Data Analysis 3 sem. hrs.

Spring, annually. Prerequisite: Permission of instructor. Hu, Jianhua and Ning, Jing. This course presents extensions of classical generalized linear models to correlated outcome data with the specific emphasis on repeated measurements. Such models arise from designs such as longitudinal studies, which are commonly encountered in biomedical and environmental research. Major topics include mixed linear models for continuous, binomial, and count data; maximum likelihood estimation; generalized estimating equations; REML, EM algorithm; current general and specialized statistical software applicable for implementing these methods; and readings from current statistical literature. This course is intended for students with a background in basic statistical theory and linear models (see Prerequisites of this course).

GS01 1163 Analysis of Microarray Data. 3 sem. hrs.

Fall, biannually. Prerequisite: Permission of instructor. Baggerly, Keith. This course is an introduction to the statistical and bioinformatic analysis of microarray data. The course covers both Affymetrix oligonucleotide arrays and two-color fluorescence cDNA microarrays. The course introduces students to the full range of processing microarray experiments, from experimental design, through image processing, background correction, normalization, and quality control, to the downstream statistical analysis of differential expression. The course includes coverage of the key statistical concept of multiple testing. The course covers common

methods of pattern identification and pattern recognition in the context of microarrays. It also includes the bioinformatic interpretation of the results through tools to interact with public genome databases. All concepts will be illustrated through hands-on interaction with publicly available microarray data sets. Homework assignments will require some knowledge of statistical programming language "R." The course will include a brief introduction to programming language R. In addition to biweekly assignments, student performance will be assessed through presentation of a final project.

GS01 1173 Modern Multivariate Statistics and Applications. 3 sem. hrs.

Spring, biannually, even-numbered years. Prerequisite: Permission of instructor, Introduction to Biostatistics and Bioinformatics and knowledge of linear algebra. Guindani, Michele. This course will provide a general overview of the current state of multivariate statistical analysis in an age of high speed computation and large datasets, mixing new algorithmic techniques for analyzing large multivariate datasets with some of the most classical multivariate techniques. The learning is integrated with examples and applications in different fields, e.g., bioinformatics, genomics, chemometrics, psychology and medical science. At the end of the course, students should be able to plan and conduct analyses on high-dimensional datasets.

GS01 01183 Mathematical Statistics II. 3 sem. hrs.

Fall, annually. Prerequisite: Mathematical Statistics I. Shete, Sanjay. This course is a continuation of Mathematical Statistics I. In this semester, the course covers the foundations of statistical inference, including the theory of point and set estimation, hypothesis testing, linear models, asymptotics, decision theory, and Bayesian theory.

GS01 1203 Advanced Bayesian Statistics 3 sem. hrs.

Fall, biannually, even-numbered years. Prerequisites: Permission of instructor, Introduction to biostatistics and Bioinformatics and Bayesian Data Analysis. Guindani, Michele.

This is an advanced course covering modern topics in Bayesian statistical analysis. Knowledge of basic Bayesian statistics at the level of the GSBS GS011013 course is assumed. The course will consist of a number of major modules. For each module, there will be introductory lectures from the instructors and then readings and class presentations/discussions from the students. The final project will be an analysis of data with models/methods covered in class. Throughout the course, familiarity with some software (R, C, C++, WinBUGS or Matlab) will be assumed. Throughout the course, models and computational methods will be introduced with emphasis on applications to real data problems. The course is cross-listed at Rice University (Stat 522). The venue of the course will be at Rice University.

GS01 1213 Introduction to Mathematical Probability. 3 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Shete, Sanjay. This course presents the basic ideas of probability theory in an axiomatic framework. The idea of a probability space is presented, and the idea of a random variable is given. Also included are conditioning and independence, and an introduction to Markov chains. The course also presents the idea of a function of a random variable and how to find its distribution and moments. Finally, the course presents probability distributions (discrete and continuous).

GS01 1813 Topics in Clinical Trials.

3 sem. hrs.

Spring, odd-numbered years. Prerequisite: Prior courses in probability and statistics, permission of the instructor. Hobbs, Brian. This course deals with fundamental concepts in the design of clinical studies ranging from early dose-finding studies (phase I) to screening studies (phase II) to randomized comparative studies (phase III). The goal is to explore the statistical issues involved in clinical trials, to introduce various clinical trial designs, and to prepare the student to read the clinical trial literature critically. Additionally, faculty will introduce newer designs for clinical studies that incorporate prior knowledge and/or satisfy optimal considerations. Topics include basic study design options, sample size calculation, randomization, trial conduct, interim monitoring, data analysis, adaptive designs, multiple endpoints, meta-analysis, decision analysis, Bayesian methods, innovative phase I and II trial designs, and writing up the results of a clinical trial for publication.

COURSE OFFERINGS IN MEDICAL PHYSICS

**GS02 1011 Radiation-Induced Late Effects and Survivorship
Journal Club.**

1 sem. hr.

Fall and Spring, annually. Prerequisite: Medical Physics Program or consent of instructor. Mirkovic, Dragan. 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.

GS02 1012 Physics of Positron Emission Tomography.

2 sem. hrs.

Summer, biannually. Prerequisites: Radiation Detection, Instrumentation, and Data Analysis (GS021053) and Introduction to Medical Physics II: Medical Imaging (GS021093) or Introduction to Medical Physics IV: The Physics of Nuclear Medicine (GS021193). Mawlawi, Osama. 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.

GS02 1014 Fundamental Biological Principles of Molecular Imaging and Therapeutics. 4 sem. hrs.

Spring, annually. Prerequisites: Consent of instructor. Stafford, R. Jason. This course covers the biological principles that form the basis for molecular imaging and therapeutics. It is an introductory course that assumes that the student has completed at least one year of general chemistry and, preferably, at least one semester of biology. It is further assumed that the student has a firm understanding of calculus and ordinary differential equations. Topics covered include the fundamental aspects of biochemistry, cell biology, and cancer biology needed to appreciate and understand critical concepts in the applications of modern molecular imaging and therapeutics. Applications and examples of key concepts to molecular imaging and/or therapeutics are provided throughout the course. The course is designed for students in the Medical Physics Program, but is also open to students in other programs who are in need of an introduction to molecular and cellular biology. This course fulfills the GSBS Molecular area breadth requirement.

GS02 1022 Special Radiation Treatment Procedures. 2 sem. hrs.

Summer, annually. Prerequisite: Introduction to Medical Physics I (GS021093), Introduction to Medical Physics III: Therapy (GS021113), and Introductory Radiation Therapy Physics Rotation (GS021154). Court, Laurence. The main goal of this course is to introduce students to special radiation therapy and image-guided therapy procedures that are considered "non-routine" or in "advanced" form relative to the current clinical practice and may require special consideration in the preparation and execution. Special procedures are important clinical services which are usually provided directly by the clinical medical physicist. The special procedures selected in this course may change overtime. Currently, the following topics are included: image-guided radiotherapy procedures; total skin and total body irradiation techniques; fetal and pacemaker dosimetry; commissioning of IMRT planning systems; 4D CT imaging procedures; CyberKnife treatments; and tomotherapy treatment techniques..

GS02 1032 Principles of Magnetic Resonance Imaging. 2 sem. hrs.

Summer, biannually. Prerequisite: Introduction to Medical Physics II (GS021103) or consent of instructor. To be determined. 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.

GS02 1042 Radiation Biology. 2 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Ibbott, Geoffrey; Followill, David. This course will cover the fundamentals of radiation biology for graduate students of biophysics, radiation biology or medical physics. This course fulfills the GSBS Cellular area breadth requirement.

GS02 1053 Radiation Detection, Instrumentation, and Data Analysis. 3 sem. hrs.

Spring, annually. Prerequisite: Introduction to Medical Physics I (GS021093) or equivalent, and permission of instructor. Kry, Stephen. 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.

GS02 1093 Introduction to Medical Physics I: Basic Interactions. 3 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Starkschall, George. This semester covers the basic interactions of ionizing and non-ionizing radiation important in medicine. Topics include production of radiation; photon, charged-particle, and neutron interactions; cavity theory; radiation interactions with solids; and ultrasound interactions.

GS02 1103 Introduction to Medical Physics II: Medical Imaging. 3 sem. hrs.

Spring, annually. Prerequisite: Introduction to Medical Physics I (GS021093). Rong, John. This course includes the production of x-rays, conventional x-ray radiology, fluoroscopy, mammography as well as digital x-ray imaging modalities, computed tomography, ultrasound and picture archiving and communication systems (PACS). It covers the basic principles of medical imaging physics, the fundamental characteristics of each imaging modality, the major components of medical imaging systems, the principles of image formation and reconstruction, the attributes used to assess the performance and image quality of an imaging system, and the radiation dose to patients and personnel.

GS02 1113 Introduction to Medical Physics III: Therapy. 3 sem. hrs.

Spring, annually. Prerequisite: Introduction to Medical Physics I (GS021093). Salehpour, Mohammad. 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.

GS02 1133 Introduction to Radiation Protection. 3 sem. hrs.

Summer, annually. Prerequisite: Radiation Detection, Instrumentation, and Data Analysis (GS021053) or permission of instructor. Kudchadker, Rajat. 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.

GS02 1142 Anatomy and Oncology for Medical Physicists. 2 sem. hrs.

Fall, annually. Prerequisite: none. Jones, A. Kyle. The course provides an introduction to medical terminology and concepts in anatomy, physiology, radiology, oncology, and treatment for the medical physicist. Radiologic anatomy of the head and neck, thorax, abdomen, and pelvis is taught in order to understand imaging and the pathology of cancer in these regions. This course fulfills the GSBS Systems area breadth requirement.

GS02 1154 Introductory Radiation Therapy Physics Rotation. 4 sem. hrs.

Fall and Spring, annually. Prerequisite: Introduction to Medical Physics III (GS021113) or permission of instructor. Beddar, Sam. This course provides the student the opportunity to obtain first clinical exposure to radiotherapy. The student will observe and participate in dosimetry clinics and be asked to perform routine duties in dosimetry. The student will calibrate radiation beams, perform quality assurance tests, observe patient treatments, and do treatment planning in both brachytherapy and external beam.

GS02 1174 Introductory Diagnostic Imaging Rotation. 4 sem. hrs.

Summer, Fall and Spring, annually. Prerequisite: Introduction to Medical Physics II (GS021103); note that Introduction to Medical Physics IV (GS021193), Radiation Detection, Instrumentation and Data Analysis (GS021053) and Introduction to Radiation Protection (GS021153) may be taken concurrently; or permission of instructor. Willis, Charles. This rotation provides the student the opportunity to obtain clinical and practical exposure to diagnostic imaging and physics practices. In addition to the observation of diagnostic studies in radiography (e.g., general radiology, CT, MRI), ultrasound and nuclear medicine, performance of specific calibrations, and quality-assurance equipment measurement is required of the student. The student will observe patient diagnostic studies, observe the performance of radiological diagnosis, and perform calibration and quality-assurance tests on diagnostic imaging equipment.

GS02 1183 Applied Mathematics in Medical Physics. 3 sem. hrs.

Fall, annually. Prerequisite: Nine hours or equivalent of calculus and/or analysis and completion of admission deficiencies. Ma, Jingfei. This course consists of a brief review of calculus, linear algebra, and complex variables. Statistical theory and methods appropriate to medical and physical sciences are covered. The course also covers convolutions, transforms, modulation transfer functions and numerical methods. This course fulfills the GSBS Quantitative area breadth requirement.

**GS02 1193 Introduction to Medical Physics IV:
The Physics of Nuclear Medicine. 3 sem. hrs.**

Spring, annually. Prerequisite: Introduction to Medical Physics I (GS021093), Radiation Detection, Instrumentation, and Data Analysis (GS021053) (may be concurrent) or permission of instructor. Wendt, Richard. 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.

GS02 1203 Electronics for Medical Physicists.

3 sem. hrs.

Fall, annually. Prerequisite: Undergraduate electronics course covering basics of analog and digital circuits, or permission of instructor. Bankson, James. This course emphasizes the analog and digital electronics associated with scientific instrumentation, particularly as related to medical physics technology. Topics include review of analog DC and AC circuit analysis and the use of voltage regulators, filters, polyphase circuits, and operational amplifiers in medical physics instrumentation. The production and detection of RF signals and shielding/grounding techniques for noise reduction will be addressed. Digital logic and components, including gates, flip-flops, ADCs, and DACs, will be reviewed and their use in medical physics instrumentation will be discussed. Common microprocessor interfaces and computer networking schemes will also be reviewed.

GS02 1731 Medical Physics Seminar.

1 sem. hr.

Fall and Spring, annually. Prerequisite: None. Starkschall, George (Fall); Johnson, Jennifer (Spring). 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, faculty and staff speak to students about ongoing research and research opportunities for students. The objectives are to familiarize students with ongoing research and to assist them in selecting research topics.

COURSE OFFERINGS IN BIOCHEMISTRY

GS03 1011 Emerging Fields in Biochemistry and Molecular Biology: RNA Biology. 1 sem hr.

Spring, annually. Prerequisite: none. Wagner, Eric. The goal of this minicourse is for students to develop grant writing and peer review skills in the context of learning cutting edge RNA biology. The class will be divided into 11 modules (twice per week) that are each 1.25 hours-long focused on new topics in RNA biology: noncoding RNA, the CRISPR/CAS system, and RNA chemical modifications. The fourth and eleventh classes will be discussion-based and run primarily by a teaching assistant with some guided input from the course director or guest lecturer. The first of these two discussions will focus on what constitutes writing a successful proposal and peer review. The last class will be a "mock study section" moderated by the teaching assistant and instructors to review proposals. Students are required to write a 2-page, NIH-style proposal based upon the papers discussed in class. After the students turn in their proposals, the instructors will de-identify and redistribute the proposals back to the students. The students will then be required to write short critiques on two, randomly-assigned proposals (1/2 page each) and present them at the peer review held during the last class. The class is pass/fail and is contingent on the completion of the required written proposal and written critiques.

GS03 1012 Mass Spectrometry in Biomedicine.

2 sem. hrs.

Summer, annually. Prerequisite: none. Zhou, Dapeng and Hawke, David. This course provides an introduction to mass spectrometry (MS) principles and most cutting edge MS instruments, as well as their application in fields of functional proteomics, glycomics and lipidomics. Lectures focus on the theory of modern methods of ionization for biomolecules, instrumentation (4700 MALDI TOF/TOF Analyzer and LTQ-XL Linear Ion Trap MS), practical applications with specific examples, and the advantages and limitations of each method. Biological applications

of functional proteomics, glycomics, and lipidomics will be presented, which will include connection of conventional biochemistry methods to MS methods, optimal MS methods and MS methods adapted to various chromatographic techniques.

GS03 1021 Emerging Fields in Biochemistry and Molecular Biology: Translational Science and Molecular Medicine. 1 sem. hr.

Spring annually. Prerequisite: none. Xia, Yang. The goal of this minicourse is for students to develop grant writing and peer review skills in the context of learning cutting edge Translational Science. The class will be divided into 11 modules (twice per week) that are each 1.25 hours-long focused on new topics in Molecular Medicine: hemolytic disorders, hypertension and autoimmunity, aneurysms, Lyme disease, and pulmonary disorders. The fourth and eleventh classes will be discussion-based and run primarily by a teaching assistant with some guided input from the course director or guest lecturer. The first of these two discussions will focus on what constitutes writing a successful proposal and peer review. The last class will be a "mock study section" moderated by the teaching assistant and instructors to review proposals. Students are required to write a 2-page, NIH-style proposal based upon the papers discussed in class. After the students turn in their proposals, the instructors will de-identify and redistribute the proposals back to the students. The students will then be required to write short critiques on two, randomly-assigned proposals (1/2 page each) and present them at the peer review held during the last class. The class is pass/fail and is contingent on the completion of the required written proposal and written critiques.

GS03 1031 Emerging Fields in Biochemistry and Molecular Biology: Advanced Cell Signaling. 1 sem. hr.

Fall, annually. Prerequisite: none. Boehning, Darren. The goal of this minicourse is for students to develop critical analysis and presentation skills in the context of learning cell signaling. The class will be divided into 11 modules (twice per week) that are each 1.25 hours long, focused on new topics in second messenger signaling with a focus on calcium signaling and associated cutting edge technical approaches for monitoring cell signaling pathways in vivo. The course will be divided into two lectures followed by a presentation and critical analysis of current literature.

GS03 1102 Current Methods in Molecular Research I. 2 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Xia, Yang. This course provides an introduction to current methods for the study of biomolecules, including proteins and nucleic acids. Lectures focus on the theory, instrumentation, practical applications with specific examples, and the advantages, disadvantages, and limitations of each method. Methods used primarily for the study of nucleic acids will be presented and will include protein expression systems, nucleic acid hybridization, PCR, genomic and cDNA cloning, antibody techniques, transfection, transgenic models, site directed mutagenesis, and enzymes as tools in molecular biology research. This course, in combination with GS03 1112 Current Methods in Molecular Research II, fulfills the GSBS Quantitative area breadth requirement.

GS03 1112 Current Methods in Molecular Research II. 2 sem. hrs.

Spring, annually. Prerequisite: Consent of instructor. Putkey, John. This course provides an introduction to current methods for the study of biomolecules, including proteins and nucleic acids. Lectures focus on the theory, instrumentation, practical applications with specific examples, and the advantages, disadvantages, and limitations of each method. Methods

used primarily for the study of proteins will be presented and will include optical methods, hydrodynamics, various chromatographic techniques, methods used in equilibrium and kinetic studies, radioisotopic methods, nuclear magnetic resonance, mass spectrometry, and methods used to determine protein primary and secondary structure. This course, in combination with GS03 1102 Current Methods in Molecular Research I, fulfills the GSBS Quantitative area breadth requirement.

GS03 1711 Seminars and Literature Study in Biochemistry and Molecular Biology. 1 sem. hr.

Fall and Spring, annually. Prerequisite: General knowledge of biochemistry. Serysheva, Irina. This course will consist of formal seminars given by staff and visiting scientists in the broad disciplines of biochemistry and molecular biology.

COURSE OFFERINGS IN CELLULAR, MOLECULAR AND DEVELOPMENTAL BIOLOGY

GS04 1012 Clinical Principles of Cancer Metastasis. 2 sem. hrs.

Fall, annually. Prerequisite: Instructor approval and/or a passing grade in each of the following: GS041063: Cancer Biology; GS041133: Cancer Cell Signaling; GS041093: The Biology of Cancer Metastasis. Kopetz, Scott. This course will introduce fundamental principles and clinical experiences of the care of cancer patients, with an emphasis on the continuum of treatment modalities, interventional trials, and translation of scientific advances to clinic from the perspective of cancer patients and clinical care providers. Each week, students will attend a once-hour lecture followed by a two-hour patient care observation module in various clinical settings.

GS04 1013 Cell Biology. 3 sem. hrs.

Fall, annually. Prerequisite: General background in biology and biochemistry. Enrollment limited to GSBS degree-seeking students. Frost, Jeffrey. This course is designed to develop a functional understanding of cell biology. It is organized into four general sections: eukaryotic cell organization and function; dynamics of organellar components; physiological regulation of cell function; and, cell-cell interactions. The course format includes lectures, round-table discussions, and didactic presentations. This is an introductory course with an interdisciplinary emphasis for students in cell and regulatory biology programs. This course fulfills the GSBS Cellular area breadth requirement.

GS04 1022 Vascular Biology: Basic Science to Clinical Research. 2 sem. hrs.

Spring, annually. Prerequisite: None. Open to all GSBS students. Geng, Yong-Jian. The blood vessels constitute the largest tubing system that transports blood between the heart and other organs and tissues. Vascular diseases are the leading cause of death and disability. This advanced biomedical science course is designed to explore modern concepts of vascular biology and human vascular diseases, and will introduce and discuss current basic and clinical advances in the field. The course will emphasize molecular aspects of vascular biology, physiopathological processes, and the development of advanced therapeutic technology in vascular disease. A unique feature of the course is its integration of basic and clinical research, with a focus on

translational research. The aspects of vascular biology to be covered include development, cell biology, genomics, disease processes, and therapeutic approaches. Lecturers will be drawn from researchers and clinicians in the field from several institutions in the Texas Medical Center, including UTHealth, MD Anderson Cancer Center, Baylor College of Medicine, and Rice University. The focus on current research directions will provide excellent opportunities for students interested in vascular biology as they plan their own research careers.

GS04 1032 Molecular Epidemiology. 2 sem. hrs.

Spring, even-numbered years. Prerequisite: None. Wu, Xifeng. The causes of most chronic diseases in the general population involve the interaction of inherited genotypes, somatic genetic damage, exogenous exposures, and endogenous metabolic pathways. A complete understanding of disease etiology may therefore require a multidisciplinary approach that draws on methods from epidemiology, statistics, classical genetics, and molecular biology. In addition to an overview of molecular biology and epidemiology, this course will present methods and techniques for molecular epidemiology studies. Emphasis will be placed on the application of biomarkers. Advantages and limitations of using biomarkers in epidemiologic studies will be discussed.

GS04 1042 Stem Cells in Biomedicine. 1 sem. hr.

Spring, annually. Prerequisite: Permission of instructor. Wassler, Michael. A stem cell is a cell from the embryo, fetus, or adult that, under certain conditions, has the ability to reproduce itself for long periods or, in the case of adult stem cells, throughout the life of the organism. It also can give rise to the specialized cells that make up the tissues and organs of the body. Much basic understanding about embryonic and adult stem cells has come from animal research and from stem cell lines established from embryonic tissues. The objective of this course is to provide students information on stem cell biology and the latest development in animal and human stem cell research and application. This course will offer students an opportunity to improve their knowledge of adult and embryonic stem cells and master this research tool for their studies. The long-term objective of this course is to increase the number of researchers who have both the knowledge and skills in the use of animal and human stem cells. Students will receive a review of basic stem cell biology and experimental/clinical application of stem cells in biomedicine for the use of human biological materials, including proper exposure precautions, safe methods of disposal, and scientific record keeping. Students will also have the opportunity to learn recent development in stem cell research in both basic and clinical medicine. A group of scientists with broad expertise on stem cell biology, biochemistry, and clinical application will teach portions of this course.

GS04 1043 Molecular Principles of Virology. 3 sem. hrs.

Fall, annually. Prerequisite: None. Sastry, Jagan. This general virology course places emphasis on both DNA and RNA animal viruses in terms of their properties, identification, classification, virus-host cell interactions, mechanisms of virus replication, and virus-induced transformation. The involvement of tumor viruses in the neoplastic disease process also is presented. This course fulfills the GSBS Systems area breadth requirement.

**GS04 1051 Fluorescence and Electron Microscopy:
Imaging Cells and Molecules. 1 sem hr.**

Spring, annually. Prerequisite: General knowledge of microbiology and biochemistry and consent of instructor. Hung, Ton-That and Liu, Jun. Fluorescence and electron microscopes permit the examination of cellular features at high magnification. This 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 will be able to prepare specimens, operate the instruments, and collect and interpret data. This is a laboratory course with advanced microscopic techniques emphasis for students in the Microbiology and Molecular Genetics Program.

GS04 1062 Methods in Cancer Mestastasis Research. 2 sem. hrs.

Summer, annually. Prerequisite: Permission of instructor, and all students will comply with the MD Anderson IACUC resolutions and must have completed appropriate animal care and handling training tapes prior to taking the course. Gallick, Gary; Fidler, Isaiah J. This course is designed to provide students with in-depth training in some of the most important methods in cancer metastasis research: microscopy, tumor histopathology, and the use of orthotopic mouse models for tumor growth (primary and metastasis). The course will be taught over two weeks - four hours a day for the first week and six hours a day for the second week. The first week will cover principles of tumor histopathology and will be taught by a practicing board-certified pathologist from UT MD Anderson Cancer Center and an expert microscopist. The second week will cover the use of orthotopic mouse models for the study of human tumor growth and pathogenesis. Didactic lectures will begin each day, but the majority of the course will be "hands-on" bench work, and provide the opportunity for students to learn firsthand the most important techniques being used in the study of cancer metastasis.

GS04 1063 Cancer Biology. 3 sem. hrs.

Spring, annually. Prerequisite: General knowledge of biochemistry or permission of instructor. Lee, Mong-Hong. This is a lecture course on aspects of recent progress and active research in cancer biology. Topics will include tumor/host interactions, metastasis and invasion, tumor cell biochemistry, tumor heterogeneity, therapy, cell surfaces, and development aspects, and is an introductory course for the Program in Cancer Biology. This course fulfills the GSBS Systems area breadth requirement.

GS04 1072 Principles of Stem Cell Biology. 2 sem. hrs.

Fall, annually. Prerequisite: None. Davis, Brian and Zsigmond, Eva. Stem cells, be they embryonic or somatic, play crucial roles in the development and functional maintenance of individual organ systems and complete organisms. As has already been well demonstrated for the blood-forming system through bone marrow transplantation, stem cells can be utilized clinically for treatment of genetic or acquired diseases. The ensuing decades will undoubtedly provide many more successful clinical applications of stem cells in regenerative medicine. Stem cells may also play critical roles themselves in the initiation and maintenance of certain diseases, such as cancer. This course will provide a present-day understanding of the precise definition, molecular characterization, and biological function of stem cells. The course focus will primarily be on fundamental issues regarding stem cells, and less on their wide range of potential future

applications. Completion of this course should adequately prepare students to both identify and understand fundamental issues in current stem cell research, as well as to permit students themselves contribute to advancing this field through research.

GS04 1073 Developmental Biology. 3 sem. hrs.

Spring, annually. Prerequisite: Consent of instructor. Behringer, Richard. 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. Topics covered will include cell-to-cell communication, patterning of the embryo, tissue morphogenesis, cell differentiation and stem 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 and evolution. The course is lecture-based but will emphasize the experimental evidence underlying the basic principles of Developmental Biology and will discuss current debates and recent findings that have yet to be simplified for textbook presentation. This course fulfills the GSBS Systems area breadth requirement.

GS04 1083 Basic Concepts of Tumor Biology. 3 sem. hrs.

Spring, odd-numbered years. Prerequisite: Consent of instructor. Richie, Ellen. This is a comprehensive survey course of cancer biology including tumor pathology, initiation, progression and metastasis, genetic instability, DNA damage and repair, cell cycle control, oncogenes, tumor suppressor genes, and the immune response. This course is taught at the UT MD Anderson Cancer Center Science Park in Smithville, Texas. This course fulfills the GSBS Systems area breadth requirement.

GS04 1093 The Biology of Cancer Metastasis. 3 sem. hrs.

Spring, annually. Prerequisite: Consent of instructor. Gallick, Gary. 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 three major metastatic human cancers. This course fulfills the GSBS Cellular area breadth requirement.

GS04 1103 Principles of Therapeutics. 3 sem. hrs.

Spring, annually. Prerequisite: Basic understanding of biochemistry and cell biology. Hittelman, Walter. This course will establish a foundation of the principles of therapeutics and will introduce students to the principles and history of therapeutics the current state of drug development. The course is structured so that students are introduced to human genome and causes of disease. A session will focus on target identification, protein crystallography, molecular modeling, and structure-based drug design and medicinal chemistry that will include drug design, synthesis, optimization, lead product identification, and chemical synthesis of lead product. Other sessions will focus on how chemicals serve as genetic modifiers and will introduce students to high throughput drug screening and siRNA screening. Toxicity and pharmacology play major roles in drug design, drug dosing, drug schedule, and route of administration. The role of biomarkers, genomics, and proteomics will be included with an emphasis on therapeutics. Students will

be introduced to diverse strategies for therapy that includes natural products, immunotherapy, gene therapy, and blood and marrow transplantation. A review of the process of moving a drug from laboratory to clinic will finish the course and will introduce students to translational and clinical research.

GS04 1113 Molecular Biology of Cancer. 3 sem. hrs.

Spring, odd-numbered years. Prerequisite: Cancer Biology (GS041063) or Basic Concepts of Tumor Biology (GS041083) or permission of instructor. Johnson, David. This course covers fundamental molecular biology processes with an emphasis on how normal mechanisms of genome maintenance, gene expression, signaling, and metabolism become misregulated during cancer development. The course is divided into three modules: i) DNA structure, repair, and mutagenesis, ii) regulation of gene expression and chromatin dynamics, and iii) cell signaling and metabolism. Lectures on DNA structure, replication, transcription, and protein translation provide basic introductory material that is built upon in other lectures focused on various DNA repair pathways and epigenetic mechanisms regulating chromatin structure and function. Signaling and metabolic pathways important for cancer development are also included as course topics. Assigned reading material will come from the primary literature and be discussed in class. This course fulfills the GSBS Molecular area breadth requirement.

GS04 1123 Molecular Biology of Eukaryotic Cells. 3 sem. hrs.

Spring, annually. Prerequisite: Permission of instructor. Tyler, Jessica. This is an advanced molecular biology course on the fundamental cellular processes that are often disrupted in cancer. Topics covered fall under the broad realm of gene expression and include the packaging of the genome into chromatin (epigenetics), transcriptional regulation, splicing, protein synthesis, protein degradation, signaling, cell cycle, apoptosis, DNA replication and repair. The current state of knowledge of these basic processes will be covered and will include up to date information from recent primary journal articles. This course fulfills the GSBS Molecular area breadth requirement and Genes and Development Program requirement.

GS04 1133 Cancer Cell Signaling. 4 sem. hrs.

Spring, annually. Prerequisites: A basic knowledge of molecular biology, genetics and biochemistry or permission of instructor. Boyd, Douglas. The course is designed to provide an in-depth study of oncogenes including structure of the genes, regulation of expression, assays to detect activated oncogenes, role of oncogenes in tumorigenesis, and the relationship of oncogenes and growth regulation and differentiation. This course satisfies the GSBS Cellular area requirement.

GS04 1183 Molecular Methods and Biotechniques. 3 sem. hrs.

Spring, even years. Prerequisite: One semester of core coursework. Wood, Richard and Shen, Jianjun. This course will introduce graduate students, at an early stage of their research careers, to a wide variety of methods and techniques especially applicable to research in modern molecular biology. The course will feature a diverse group of instructors, each of them possessing a specialized research knowledge of a particular group of molecular methods and biotechniques. Each instructor will combine classroom lecture with an in-laboratory demonstration. The lecture-demonstrations are grouped into three modules covering the general areas of biochemical, cell biology, and whole organism methods and techniques. Students will learn about the theoretical basis of commonly used modern methods and techniques for

research in molecular biology, about the different types of information that can be gained by application of different techniques to a problem, about which techniques are most appropriate in a given situation, and about data interpretation. Students will also be introduced in a laboratory setting to the actual apparatus, equipment or devices available for most techniques.

GS04 1203 Experimental Genetics. 3 sem. hrs.

Spring, annually. Prerequisite: None. Schumacher, Jill and Behringer, Richard. This course provides students with a base of knowledge about concepts central to contemporary genetics (i.e. complementation, recombination, mutational screens, mosaic analysis, gene targeting) and covers current approaches used in the analysis of classical eukaryotic genetic systems including humans, mice, flies, nematodes, and yeast. In addition to lectures, students will participate in several computer workshops where they will have the opportunity to learn to navigate through various Internet-based bioinformatic resources useful to geneticists. This course fulfills the GSBS Systems area breadth requirement.

GS04 1213 Mechanisms in Cancer Therapeutics. 3 sem. hrs.

Fall, annually. Prerequisite: Basic understanding of biochemistry and cell biology. Hittelman, Walter. 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.

GS04 1223 Fundamental Mechanisms of Cancer Development. 3 sem. hrs.

Spring, annually. Prerequisite: None. Galko, Michael. This course emphasizes the developmental roots of cancer biology, covering major signaling pathways (RTK signaling, Hh signaling, etc.) and cell processes (cell death/apoptosis, epithelial-to-mesenchymal transitions) that are important both in normal development/homeostasis of the organism, and, when mutated or misregulated, in the progression of cancer. A series of lectures will introduce each pathway or process in cancer and then backtrack to highlight the normal developmental/homeostatic roles of the pathway/process being covered. These will be tied to a class-wide discussion of a recent or classic paper in the field that will occur every third lecture. The teaching philosophy emphasizes development of critical thinking and understanding of central concepts. This course fulfills the GSBS Systems area breadth requirement.

GS04 1731 Seminar in Developmental Biology. 1 sem. hr.

Spring, annually. Prerequisite: Permission of instructor. Galko, Michael and Arur, Swathi. This course involves weekly 90-minute meetings for student presentations on contemporary topics in developmental biology. The topics will be drawn from the current literature and will emphasize genetic and molecular approaches.

GS04 1751 Seminar in Cell Signaling and Regulation. 1 sem. hr.

Spring, annually. Prerequisite: None. Schonbrunn, Agnes. 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.

GS04 1761 Current Topics in Oncogene Research. 1 sem. hr.

Spring, annually. Prerequisite: None. Hung, Mien-Chie. This is a seminar course in which students will meet once every week. Each student is expected to give at least one seminar per semester. The seminar topic will be mainly on oncogene-related subjects from current leading journals. The objectives of the course are to develop students' oral communication skills in science and to become familiar with up-to-date literature in oncogene research.

GS04 1771 Current Topics in Tumor Progression. 1 sem. hr.

Fall and Spring, annually. Prerequisite: None. Gallick, Gary. This is a seminar course in which students meet weekly and analyze current topics in the molecular regulation of tumor progression and metastasis. Alternate faculty and student presentations of the current literature not covered in depth in other courses or formats will fulfill two objectives. First, students will learn to critically analyze, evaluate, and present current articles in this area. Second, students will learn how to critically write an NIH-type grant application which will be peer-reviewed by both the Coordinator and the students. The extension of this course to two semesters is intended for students who wish to use the Current Topics course as an accompaniment to GS040063 and GS040134, although each of these courses can also be taken independently.

GS04 1811 G & D Scientific Writing. 1 sem. hr.

Fall, annually. Prerequisite: None. Gladden, Andrew. This course is designed for second year students who have chosen their thesis lab. The students will develop a research plan based on their thesis project and write a 6-page grant in the style of a NRSA F31 application. 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.

GS04 1812 Seminars in Molecular Mechanisms of Human Cancer. 2 sem. hrs.

Fall, annually. Prerequisite: None. Nagarajan, Lalitha and Lee, Mong-Hong. This is a seminar course to provide in-depth knowledge on recent developments in human cancer research. The focus will be on the molecular basis of human neoplasia. Each week, two students will discuss background knowledge and current developments on a specific human cancer.

GS04 1821 G & D Oral Scientific Presentations.

1 sem. hr.

Spring, annually. Prerequisite: None. Gladden, Andrew. This course 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 elevator talks: one to a scientific group and one to a non-scientist group. This course is designed to prepare the student for the oral defense portion of their candidacy exam.

COURSE OFFERINGS IN IMMUNOLOGY

GS06 1013 Immunology I.

3 sem. hrs.

Fall, annually. Prerequisite: Knowledge of basic biochemistry and genetics. Schluns, Kimberly. Topics covered in this lecture series include anatomy and development of the immune system; structure, function and genetics of antibodies; T-cell antigen receptors; functions and cooperative interactions of lymphoid cells; structure and function of molecules encoded by the Major Histocompatibility Complex (MHC); lymphokines and their receptors; cellular interaction molecules; and specific immunological tolerance. Medically related subjects that will be covered from a basic science perspective include immunopathology, immunodeficiency, allergy and other hypersensitivities, autoimmunity, organ transplantation, tumor immunology, and AIDS. This course fulfills the GSBS Cellular area breadth requirement.

GS06 1102 Immunology II: Regulation of Immune Responses.

2 sem. hrs.

Spring, annually; first half of the semester. Prerequisite: Immunology I (GS061014) or permission of instructor. Instructor to be determined. Topics in this course will include antigen processing, lymphokines, development of T and B lymphocytes, antigen recognition by T lymphocytes, cellular activation, and cell interactions. Each student will read selected papers in cellular immunology and make several oral presentations.

**GS06 1112 Immunology III: Special Topics
in Molecular Immunology.**

2 sem. hrs.

Spring, annually; second half of the semester. Prerequisites: Immunology I (GS061014) and Immunology II (GS061102) or permission of instructor. Lee, Dean. This course will approach the subject of immunology from the current literature. Selected readings from the primary literature will be presented by each student, which will be used to develop a research proposal.

**GS06 1132 Application of Tumor Immunology
in the Clinical Setting**

2 sem. hrs.

Spring, annually. Prerequisites: Previous immunology course such as Immunology I or permission of instructor prior to enrollment. Naing, Aung and Lee, Dean. 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.

GS06 1611 Advanced Topics in Immunology. 2 sem. hr.

Spring, annually. Prerequisite: Immunology I and Biochemistry or permission of instructor. Ullrich, Stephen. 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.

COURSE OFFERINGS IN MICROBIOLOGY

GS07 1011 Topics in Biodefense and Emerging Infections. 1 sem. hr.

Fall, annually. Prerequisite: None. Koehler, Theresa and Norris, Steven. The broad impact of bioterrorism on scientific research and the role of scientists in preparedness and response will be addressed in a series of seminar presentations. Speakers with expertise in diverse areas, including public health response, select agent biology, diagnosis and disease management, and public policy, will present talks which will be followed by group discussion.

GS07 1063 Microbial Molecular Genetics. 3 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Lorenz, Michael. This course is an introductory graduate level course that provides the students with broad knowledge in molecular genetics, with an emphasis on molecular genetics of prokaryotic and eukaryotic microbes. Topics covered include gene and genome organization, gene expression, genetic mechanisms and genetic experimental strategies. The course is recommended for, but not limited to first-year students. This course fulfills the GSBS Molecular area breadth requirement.

GS07 1082 Microbial Sensing and Signal Transduction. 2 sem. hrs.

Fall, annually. Prerequisites: Microbiology and Molecular Genetics I (GS071014) and Microbiology and Molecular Genetics II (GS071024) and/or Cell Biology (GS041013) are recommended. Kaplan, Heidi. This is an advanced course on sensory reception and signal transduction in response to environmental stimuli. Chemoreception, photoreception, and development will be examined in prokaryotic organisms. Signaling in model eukaryotic systems, including G protein-mediated signaling, MAP kinase cascades, and other mechanisms underlying eukaryotic cell chemotaxis, differentiation, and stress responses, will also be explored. In addition, students will gain valuable experience in critically evaluating and effectively presenting primary scientific literature.

GS07 1092 Molecular Basis of Microbial Pathogenesis. 2 sem. hrs.

Spring, annually. Prerequisites: Microbiology and Molecular Genetics I (GS071014) and Microbiology and Molecular Genetics II (GS071024) or permission of instructor. Koehler, Theresa. This is an advanced level course covering current areas of interest in microbial pathogenesis. The goal of the course is to provide a comprehensive overview of the molecular basis of pathogenesis through a critical evaluation of recent scientific papers and reviews. Students, with faculty guidance, will also develop an original grant proposal on a subject of their choosing in microbial pathogenesis. Topics for discussion will include: host-pathogen signal

exchange, environmental control of gene expression, genotypic rearrangements associated with pathogenesis, toxin structure and function, bacterial attachment to host cells, invasion of host cells, intracellular growth, and cell-to-cell spread.

GS07 1113 Microbial Physiology. 3 sem. hrs.

Spring, annually. Prerequisite: Microbial Molecular Genetics (GS071014) is recommended, but not required, or permission of instructor. Margolin, William. This course offers a comprehensive examination of the structure and function of prokaryotic and eukaryotic microbial cells and their physiology. Topics covered include Structure and Biogenesis (cell cytoplasm, envelop and surface structures), Energy and Metabolism (nutrient acquisition, membrane transport, respiration, fermentation, and biosynthetic networks), Signaling and Development (signal transduction, cell-cell communication, and cell differentiation), and Pathogenesis (virulence factors and host response). The course is recommended for, but not limited to first-year students. This course fulfills the GSBS Cellular area breadth requirement.

GS07 1731 Seminar in Infectious Diseases. 1 sem. hr.

Fall, odd-numbered years. Prerequisite: Coursework or work experience in microbiology. Norris, Steven. This is a seminar course which covers the biologic and clinical basis of infectious diseases. Students will read assigned research articles, participate in group discussions, and critically analyze articles in the general areas of microbial pathogenesis, host-parasite interactions, diagnosis, therapy, and prevention.

GS07 1741 Literature Survey in Microbiology and Molecular Genetics. 1 sem. hr.

Fall and Spring, annually. Prerequisite: None. Li, Ziyiin. In this course, 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 molecular genetics. Students will be evaluated on their presentation and participation in discussions.

GS07 1751 Microbiology and Molecular Genetics Seminar Series. 1 sem. hr.

Fall and Spring, annually. Prerequisite: None. Koehler, Theresa. Students will attend the weekly departmental seminars series in the Department of Microbiology and Molecular Genetics.

COURSE OFFERINGS IN HUMAN GENETICS

GS11 1012 Cancer Genetic Counseling. 2 sem. hr.

Spring, annually. Prerequisite: Permission of instructor.. Singletary, Claire. This course is taught by the faculty and staff of UT M.D. Anderson Cancer Center and includes lectures by experts in basic science cancer research, clinical oncology, pathology, psychology and cancer genetic counseling. Some of the topics covered include overview of cancer biology and clinical oncology, hereditary colon cancer syndromes, hereditary breast-ovarian cancer syndrome, rare cancer syndromes, management of high risk patients, collecting a cancer-focused family history, hereditary cancer risk assessment models and tools, and psychosocial aspects of cancer risk assessment and counseling. Discussions led by genetic counselors and involving student

presentations focus on various hereditary cancer topics and the genetic counseling, ethical, legal, and family issues unique to this area. Students will expand and refine the knowledge and skills learned in this course during their cancer genetics rotation. This course provides students with the background necessary to offer genetic counseling services to individuals referred for cancer risk assessment and genetic testing for cancer susceptibility.

GS11 1013 Genetics and Human Disease. 3 sem. hr.

Fall, annually. Prerequisite: Permission of instructor; general genetics and statistics recommended. Hanis, Craig and Boerwinkle, Eric. 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 course objective is to provide descriptions of the analytical processes whereby genetic mechanisms are inferred and genes located on chromosomes. This course fulfills the GSBS Quantitative area breadth requirement.

GS11 1021 Psychosocial Practicum. 1 sem. hr.

Fall and Spring, annually. Enrollment required of all Genetic Counseling MS students. Open only to Genetic Counseling MS students. Carter, Rebecca and Singletary, Claire. 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.

GS11 1023 Molecular and Cellular Approaches to Human Genetics. 3 sem. hr.

Spring, annually. Prerequisite: Permission of instructor; undergraduate course in genetics required, Biochemistry or equivalent recommended. Hixson, James; Matin, Angabin; and Killary, Ann. This course will introduce the students to fundamental concepts in human genetics with emphasis in human cancer genetics, human genetic disorders and the genetics of common diseases, such as diabetes and high blood pressure. Students will gain a breadth of knowledge in the field of human genetics with lectures by genetics faculty from UT M. D. Anderson Cancer Center, UT Medical School, UT School of Public Health and Baylor College of Medicine. Lecture topics offer in-depth understanding of emerging concepts in areas of cancer genetics, genomics, epigenomics including microRNA and gene regulation, copy number variation in human disease, bioinformatics and systems biology. This course fulfills the GSBS Cellular area breadth requirement.

GS11 1031 Contemporary Issues in Genetic Counseling. 1 sem. hr.

Spring and Fall, annually. Prerequisites: Psychosocial Aspects in Genetic Counseling; Ethical Dimensions of the Biomedical Sciences. Singletary, Claire and Noblin, Sarah. 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 debating ethical case scenarios, and

participating in seminars for continued professional development. Genetic counseling students in their second year are eligible for this course.

GS11 1033 Quantitative Methods in Genetic Epidemiology. 3 sem. hr.

Spring, annually. Prerequisite: Genetics and Human Disease (GS111013). Shete, Sanjay. This course offers practical experience in the analysis of genetic marker data. The course will cover the basic theory behind linkage analysis and will focus on learning analysis techniques and computer packages.

GS11 1042 Population Genetics. 2 sem. hr.

Spring, annually. Prerequisite: Genetics, statistics, and consent of instructor. Fu, Yun-Xin and Xiong, Momiao. 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.

GS11 1053 Data Mining Methodology. 3 sem. hr.

Spring, annually. Prerequisites: Introductory statistics, genetics, basic math and algebra skills. Jamal, Jose-Miguel. This course will cover application of various novel data mining, machine learning, and artificial intelligence methods to the data analysis of large genetic epidemiology datasets. The emphasis will be on the data analysis in wide-scale (genomic, or genome-wide) association studies of complex diseases (such as CVD, or cardiovascular disease), where large numbers of small effects present numerous problems to the traditional statistical methodology. Among other methods, feature construction and feature set reduction, classification, clustering, and dependency modeling will be detailed. For comparison purposes, the course will also briefly cover applications of the same novel methodology in different but related fields (such as gene expression studies), and more traditional approaches to genetic epidemiology data analysis (such as multiple testing corrections).

GS11 1062 Human DNA Variation. 2 sem. hrs.

Spring, annually. Prerequisites: General genetics and biochemistry or permission of instructor; Genetics and Human Disease (GS111013) and Molecular and Cellular Approaches to Human Genetics (GS111023) are recommended. Daiger, Stephen. This course is a review of genetic variation in human DNA: related terms and concepts, methods for detecting variation including Southern blotting and PCR, methods for analyzing variation, and applications including linkage mapping and genetic counseling.

GS11 1073 Introduction to Genomics and Bioinformatics. 2 sem. hrs.

Fall, annually. Prerequisites: Calculus, statistics, and consent of instructor. Xiong, Momiao and Fu, Yun-Xin. This course introduces basic concepts, statistical methods and computational algorithms and tools for the creation and maintenance of databases of biological information, DNA sequence analysis, modeling of evolution, genetic studies of complex diseases including

linkage analysis, linkage disequilibrium and association studies, gene expression data analysis, and identification of biological networks. Students will be introduced to the basic concepts behind bioinformatics and computational biology tools. Hands-on sessions will familiarize students with the details and use of the most commonly used online tools and resources.

GS11 1082 Psychosocial Issues in Genetics. 2 sem. hrs.

Fall, annually. Prerequisites: Permission of instructor. Genetic counseling students only. Singletary, Claire. Psychosocial aspects of genetic counseling combines 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, grief theory, family adjustment theory, crisis intervention theory, individual adjustment theory, dealing with educated and uneducated patients, noncompliant patients, disabilities, multicultural issues, and counseling for chronic disease.

GS11 1092 Genetic Epidemiology of Chronic Disease. 2 sem. hrs.

Spring, annually. Prerequisite: None. Hanis, Craig. 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.

GS11 1103 Evolution of DNA and Protein Sequences. 3 sem. hrs.

Fall, odd-numbered years. Prerequisite: Calculus, statistics, and consent of instructor. Fu, Yun-Xin. 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. This course is cross-listed at UTHealth School of Public Health (PH1982). The venue of the course will be at SPH.

GS11 1113 Introduction to Statistical Genetics. 3 sem. hrs.

Fall, annually. Prerequisite: Genetics, calculus, statistics, and consent of instructor. Fu, Yun-Xin and Xiong, Momiao. 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 UTHealth School of Public Health (PH1986). The venue of the course will be at SPH.

GS11 1132 Introduction to Genetic Counseling. 2 sem. hrs.

Fall, annually. Prerequisite: permission of instructor; course is intended for students admitted to the specialized master of science program in Genetic Counseling. Singletary, Claire. 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. The course is taught by the Program Director with supplemental instruction from the genetic counseling program faculty. Students in the first semester of the genetic counseling program are eligible for this course.

GS 11 1142 Approaches to Genetic Counseling Research I. 2 sem. hrs.

Fall, annually. Prerequisite: Introduction to Genetic Counseling (GS11 1132). Hashmi, S. Shahrukh. 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 be exposed to research ideas in cancer, perinatal and pediatric research that would help them formulate their own thesis research questions. Genetic counseling students in their first year of study are eligible for this course.

GS11 1152 Approaches to Genetic Counseling Research II. 2 sem. hrs.

Spring, annually. Prerequisite: Approaches to Genetic Counseling Research I. Hashmi, S. Shahrukh. 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. 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 who have passed Approaches to Genetic Counseling Research I are eligible for this course.

GS11 1161 Prenatal Genetic Counseling. 1 sem hr.

Fall, annually. Open only to Genetic Counseling M.S. students. Singletary, Claire and Czerwinski, Jennifer. 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 and is facilitated by the Genetic Counseling Program faculty.

GS11 1162 Case Studies in Gene-Environment Interaction. 2 sem. hrs.

Fall, annually. Prerequisite: Molecular Genetics. Boerwinkle, Eric. This course will focus on the link between environmental factors and individual genetic factors on the incidence and progression of human disease. The method of study will be classic case studies of gene-environment interactions resulting in human diseases. The course will be taught by expert faculty and involve student presentations of classic papers. The methods of discovery and the impact of the discovery on human health will be emphasized as policies of public health are conceptualized. Experts from outside GSBS who made these sentinel discoveries will be visiting faculty.

GS11 1642 Topics in Medical Genetics II. 2 sem. hr.

Spring, annually. Prerequisite: Topics in Medical Genetics I (GS111622) Noblin, Sarah and Ashfaq, Myla. This second semester course focuses on individual topics related to the practice of Medical Genetics. Topics include dysmorphology, risk assessment, hemoglobinopathies, evaluation of organ systems with emphasis on genetic pathogenesis of malformations, and metabolic disorders. This course is a combination of didactic lectures and discussions. The lecturers are experts in their respective fields.

GS11 1711 Seminar in Genetics and Population Biology. 1 sem. hr.

Fall and Spring, annually. Prerequisite: Second year graduate standing or higher. Boerwinkle, Eric. This course involves the presentation and analysis of individual topics of research.

COURSE OFFERINGS IN PHYSIOLOGY, REPRODUCTIVE BIOLOGY, PATHOLOGY AND COMPARATIVE MEDICINE

GS12 1012 Gross Anatomy-Musculoskeletal System. 2 sem. hr.

Spring, annually. Prerequisite: none. Cleary, Leonard. The goal of this course is to teach the structures and structural relationships of the human musculoskeletal system. The vertebral column, upper and lower extremities will be described. Each lecture on a particular region will be paired with a cadaver dissection in the laboratory. Students will be assessed on the basis of their performance on two written exams and one oral presentation.

GS12 1013 Histology for Graduate Students. 3 sem. hr.

Summer, annually. Prerequisite: none. Smith, Keri and Hickson-Bick, Diane. The purpose of this course is to provide a comprehensive overview of the structure of organ systems and tissues as it relates to their normal function. Students will gain a working knowledge of tissue fixation, sectioning and processing, basic histological staining, and immunohistochemical staining. Light microscopy will be employed to understand the relationship between tissue morphology and function. Comparative studies of mouse, rat, and human tissue will be performed where applicable. Students will also gain "hands-on" experience cutting frozen tissue sections, fixing sections to slides, and performing hematoxylin and eosin and antibody-based staining. Novel technologies for whole tissue imaging will also be discussed. By the end of the course students should have a solid understanding of normal tissue structure, and should be able to apply this knowledge to their own translational research projects.

GS12 1041 Seminars in Experimental Pathology. 1 sem. hr.

Fall and Spring, annually. Prerequisite: None. Hickson-Bick, Diane. The course will consist of lectures given by faculty and visiting scientists on current research in experimental pathology. Students will attend weekly seminar presentations and meet, as a group, with visiting lecturers to discuss research and career development.

GS12 1051 Seminars in Integrative Biology & Pharmacology. 1 sem. hr.

Fall and Spring annually. Prerequisite: none. Venkatachalam, Kartik and Cunha, Shane. The Department of Integrative Biology and Pharmacology sponsors seminars by visiting scientists, and when there are no visitors, sponsors colloquia given by faculty members and postdoctoral fellows at UTHealth. The speakers are chosen by graduate students, postdoctoral fellows, and faculty members in the Department of Integrative Biology and Pharmacology. The presentations are typically at a level appropriate for graduate students. There are no prerequisites, but attendance is required.

GS12 1055 Human Gross Anatomy. 5 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Cleary, Leonard. This is a Medical School course in human gross anatomy. Major emphasis will be placed on anatomical relationships. Class time will consist largely of laboratory dissection of a human cadaver. Class size is limited and divided into pre-planned small groups.

GS12 1063 Histology. 3 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Hickson-Bick, Diane. This is a Medical School human histology course in which emphasis is placed on the cell and tissue structure and laboratory experience. A functional approach to cell, tissue, and organ structure is stressed. This course fulfills the GSBS Cellular area breadth requirement. Class size is limited to three students.

GS12 1072 Developmental Anatomy. 2 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Felleman, Daniel. This is a Medical School course in human embryology. Emphasis will be placed upon clinical aspects of the course material.

GS12 1104 Anatomy (Head and Neck). 4 sem. hrs.

Summer, annually. Prerequisite: None. Warner, Raymond and Crabtree, Leonard. This School of Dentistry course accommodates both students with limited anatomical background and advanced students who need detailed knowledge of head and neck anatomy. Basic and advanced anatomy are covered, depending upon the needs of the student. Each region is treated by a lecture followed by a dissection. A good faculty-to-student ratio and discussion in the laboratory give the student the opportunity to learn and understand the material.

GS12 1154 Introduction to Functional Histology and Pathology 4 sem. hrs.

Fall, odd-numbered years. Prerequisite: None. McArthur, Mark. This is an introductory course designed to familiarize graduate students with the basic structure and function of different tissues and organ systems. The fundamental mechanisms of cell growth, differentiation, and death will be covered. General pathological processes, as well as pathological processes unique to different organ systems, will be reviewed. The focus will be on understanding 1) how organ function and structure are interrelated, and 2) how organ structure and function determine disease susceptibility. This course fulfills the GSBS Cellular area requirement.

GS12 1164 Human Pathobiology

4 sem. hr.

Spring, annually. Prerequisite: None. Hickson-Bick, Diane. Lectures in cells, tissues and disease are designed to cover the symptoms of cellular disease and include understanding the mechanisms of cell injury and death, inflammation and repair, immunopathology, vascular disturbances and carcinogenesis. The course will include two x 1 hour lectures and a weekly 2 hour practical period during which students will examine histological and pathological specimens, be introduced to human anatomy and physiology and spend time in a clinical setting or within a clinical laboratory.

GS12 1232 Physiology of Pregnancy, Fetus and Neonate.

2 sem. hrs.

Spring, every three years. Prerequisites: Physiology, reproductive biology, endocrinology, biochemistry, and permission of instructor. Ramin, Susan. This course discusses the physiology and endocrinology of pregnancy, including maternal adaptation, fetal development, placental function, parturition, and neonatal adaptation in extrauterine life.

GS12 1254 Cell and Systems Physiology.

4 sem. hrs.

Spring, annually. Prerequisites: General biochemistry and biology/physiology. Walters, E. Terry and Berdeaux, Rebecca. This is an introductory course emphasizing the principles of physiology. Focus is on the physiological processes that have evolved from single cells and developed into integrated control processes of cell and organ systems. The course is divided into four subject areas which include cell physiology, intercellular communication and coordination, homeostasis and the regulation of physiological systems, and integration/disintegration of physiological systems. This course fulfills the GSBS Systems area breadth requirement.

GS12 1262 Cellular Basis of Cardiac Function.

2 sem. hrs.

Fall, annually. Prerequisite: Cell Biology (GS041013) or Cell and Systems Physiology (GS121254). Taegtmeier, Heinrich. This course will provide a comprehensive review of mechanisms of energy transfer in a highly specialized organ.

GS12 1442 Principles of Experimental Mouse Pathology

2 sem. hrs.

Summer, annually. Prerequisites: none. Benavides, Fernando. 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; animal study design; genetic and non-genetic mouse models of human diseases; toxicology and drug metabolism; ante mortem and post mortem pathological characterizations; and statistical analysis. Some classes will include a short demonstration (e.g., microscopy, necropsy, or imaging procedures), peer discussions and literature review, or hands-on exercises (e.g., bioinformatics and statistics). The course will feature a diverse group of instructors with a strong background on the subjects presented.

COURSE OFFERINGS IN PHARMACOLOGY AND TOXICOLOGY

GS13 1011 Computer-Aided Drug Design.

1 sem. hr.

Fall, annually. Prerequisites: None, but a basic knowledge of chemistry (2D chemical structures, amino acids, etc. is recommended. Zhang, Shuxing. 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.

GS13 1013 Medical Pharmacology I.

3 sem. hrs.

Fall, annually. Prerequisite: Permission of instructor. Dessauer, Carmen. This introductory course covers the cellular, molecular, and other pharmacological aspects of drug action in humans. Topics include a thorough discussion of the principles of pharmacology, including pharmacokinetics, drug absorption, distribution, metabolism, and excretion. Examples will include drugs that are used to regulate the activity of the autonomic nervous system, cardiovascular, pulmonary, and renal systems, and the central nervous system. This course fulfills the Pharmacology Track requirement for the Cell and Regulatory Biology Program.

GS13 1024 Molecular Basis of Cell Signaling.

4 sem. hrs.

Spring, annually. Prerequisite: Background in biochemistry and cell biology; Consent of the instructor. Clark, Richard and Du, Guangwei. 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. This course fulfills the GSBS Molecular area breadth requirement.

GS13 1063 Toxicology I: Principles of Toxicology.

3 sem. hrs.

Fall, annually. Prerequisites: Prior biological science coursework required (i.e., biology, chemistry or physiology) and permission of instructor. Smith, Mary Ann. This course presents basic principles of toxicology and their applications to the understanding of xenobiotic-induced target organ toxicity. Topics covered include toxicant disposition, mechanisms of toxicity and target organ responses to toxic agents. A broad overview of various classes of toxic agents will be presented in the context of their exposure routes, disposition, toxicologic sequelae, and mechanisms of toxicity. This course is designed to provide a foundation for understanding the complex interactions between toxicants and biologic systems. The course is cross-listed at UT School of Public Health (PH 2175). The venue of the course will be at the SPH.

GS13 1083 Toxicology II: Toxic Agents and the Environment 3 sem. hrs.

Spring, annually. Prerequisites: Toxicology I (GS131063) preferred; permission of instructor. Smith, Mary Ann. Guided readings will provide the basis for in-class discussions on current topics in toxicology. The discussions include the historical context for our understanding of toxicant-induced adverse health effects. Class activities will be based on discussions of books designed for the lay public and the scientific literature on which the books are based. Principle mechanisms of toxicity as they relate to the understanding of environmentally-induced disease form the framework for the course. In-depth reviews of various classes of environmental contaminants and their adverse health effects will be presented. The course is cross-listed at UT School of Public Health (PH 2177). The venue of the course will be at the SPH.

GS13 1111 Case Studies in Drug Development. 2 sem. hrs.

Spring, even-numbered years. Prerequisites: None. An, Zhiqiang. This course 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 both at UT Health and at 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.

COURSE OFFERINGS IN NEUROSCIENCE

GS14 1017 Neuroscience. 7 sem. hrs.

Spring, annually. Prerequisite: Permission of instructor. Enrollment limited to degree-seeking students. Dafny, Nachum. This introductory course covers the structural and functional features of the human nervous system, including the gross anatomy of the brain and spinal cord, cellular and molecular neurobiology, the major transmitter systems, and the major anatomical pathways and their functions. The emphasis is on an integrative approach to the study of the structure and function of the nervous system with lectures focusing on molecular, cellular, and systems features of brain function. This is a Medical School course that fulfills the GSBS Systems area breadth requirement.

GS14 1021 Topics in Neurobiology of Disease. 1 sem. hr.

Fall, annually. Prerequisite: None. Byrne, John. This course provides integrated approach to neurological diseases, which includes background information as well the diagnosis, the treatment, and the biological mechanisms of the diseases under study. This course will explore grand challenges in understanding the underlying mechanisms and future treatments of a variety of neurological diseases and disorders including: tumors, developmental and mood disorders, Alzheimer's disease, addiction, epilepsy, movement disorders, spinal cord and traumatic brain injury, and vascular diseases and stroke. In addition, diagnostic and therapeutic methods including neurological imaging and stem cell therapies will also be discussed. This course is open to graduate and medical students, postdoctoral fellows, and residents.

**GS14 1022 Theory, Content, and Execution
in Cognitive Neuroscience.**

2 sem. hrs.

Fall, Spring, Summer, annually. Prerequisite: Consent of instructor. Sereno, Anne B. and Wright, Anthony A. This course is designed to provide students with the skills necessary to become successful cognitive neuroscientists. Students will receive instruction in designing experiments and analyzing data, selecting research topics, relating theory to their work, and how to stay up-to-date on current research. Students will be instructed in making presentations including PowerPoint, handouts, and effective use of white board, and will be given feedback by faculty and fellow students following their presentations. Students can register for the course multiple times during their graduate careers. Among topics covered each term will include: comparative cognition, evolution of behavior, cognitive modules, brain disorders including neurologic, developmental, and psychiatric disorders, voluntary and reflexive orienting, perception, spatial attention, feature-selective attention, item-specific learning, if-then rule learning, relational learning, abstract concept learning, familiarity memory, recollective memory, what-where-when memory, episodic memory, and working memory. These issues will be thoroughly discussed during the Theory, Content, and Execution in Cognitive Neuroscience I, II, & III courses. The particular combinations of issues in any one of these courses will vary depending upon the background and needs of the students registered for the courses and the nature of the important articles appearing in journals covering these areas.

GS14 1023 Cognitive Neuroscience I.

3 sem. hrs.

Fall, odd numbered years. Prerequisite: Prior exposure to neuroscience and cognitive psychology, or permission of the instructor. Sereno, Anne. The course will begin with a brief review of the history of understanding mental processes. The course will then cover basic concepts of brain organization and various methods used in cognitive neuroscience. The course will cover a number of cognitive processes, including the perception of color, motion, objects, and faces, as well as higher order cognitive processes, including aspects of multisensory integration, attention, and inattention. A primary goal of cognitive neuroscience is to bridge the gaps between cognitive science, systems neuroscience, computational neuroscience, and cellular neuroscience. The selected topics will illustrate examples where these bridges are being made. Reading assignments will assist in the acquisition of the basics of perception, human neuroanatomy, and neurophysiology. These readings will also be used to expose students to a number of different techniques used in Cognitive Neuroscience. Finally, some of the readings will aim to foster an understanding of how disruption of these functions are related to neurological, psychopathological, and developmental disorders, with the ultimate goal of showing how a better understanding of the underlying biological mechanisms of these cognitive functions may be useful in diagnosis or treatment

GS14 1024 Systems Neuroscience

4 sem. hrs.

Spring, annually. Prerequisite: Permission of instructor. Dragoi, Valentin. This course covers the key concepts in systems neuroscience that allow students to understand how individual neurons and circuits process information and how they modulate behavior. Emphasis is placed on the basic structure and function of cells and networks residing in the nervous system. The course covers the major available techniques to examine the operation of neurons and networks in vivo. The principles of functional neuroanatomy are presented by highlighting the main types of neuronal circuits that constitute the building blocks of systems neuroscience. The neural development section is intended to offer students insight into the early 'shaping' of neuronal

GS14 1053 Introduction to Functional Magnetic Resonance Imaging.

3 sem. hrs.

Fall, even-numbered years. Prerequisite: Neuroscience (GS14 1017). Beauchamp, Michael. Functional Magnetic Resonance Imaging (fMRI) is an exciting technique that allows brain activity to be measured non-invasively in human subjects. fMRI has revolutionized research in neurobiology and psychology by allowing direct observation of the neural processing that underlies interesting human behaviors, such as learning, memory, language, perception and decision-making. This course provides a comprehensive introduction to all aspects of fMRI. In the lecture portion of the course, participants will learn about the methods and applications of fMRI. In the hands-on section of the class, participants will have the opportunity to design experimental paradigms and collect and analyze fMRI data using the research-dedicated 3 Tesla scanner in the UT MRI Research Facility.

GS14 1062 Molecular Neurobiology – Foundations Course Complement.

2 sem. hrs.

Fall, annually. Prerequisite: Concurrent enrollment in, or past completion of, GS21 1017 Foundations of Biomedical Research. This course is a graduate level treatment of the molecular, cellular, and biochemical events that underlie neuronal function primarily for first year students intending to join the Neuroscience Program. This 2-credit version of the course is to be taken in parallel with the required first year course, GS21 1017 Foundations of Biomedical Research, and has been adapted to minimize redundancies with the material covered there. Emphasis is placed on the basic chemistry and biology of cells residing in the nervous system. The course also covers the structure and function of receptors, channels and pumps and the neurochemistry of specific transmitter systems. The unique demand of neurons as specialized secretory cells is also covered. Finally, development and maturation of the central nervous system is taught at the cellular level along with a discussion of the molecular basis of diseases affecting the nervous system. The intent is to provide students with fundamental knowledge of the workings of cells generally and neurons specifically. This course fulfills the Neuroscience Program Molecular Area requirement.

GS14 1063 Molecular Neurobiology.

3 sem. hrs.

Fall, annually. Prerequisite: None. Waxham, M Neal. This course is a graduate level treatment of the molecular, cellular, and biochemical events that underlie neuronal function. Emphasis is placed on the basic chemistry and biology of cells residing in the nervous system. The course also covers the structure and function of receptors, channels and pumps necessary for neuronal function and the neurochemistry of specific transmitter systems. The unique demand of neurons as specialized secretory cells is also covered. Finally, development and maturation of the central nervous system is taught at the cellular level along with a discussion of the diseases of the nervous system focusing on the molecular aspects of the disease process. The intent is to provide students with fundamental knowledge of the workings of cells generally and neurons specifically. An undergraduate level course in cell or molecular biology is highly recommended. This course fulfills the GSBS Molecular area breadth requirement and is intended for Neuroscience students who have elected not to take GS21 1017 Foundations of Biomedical Research.

GS14 1072 Seminar in Molecular Neuroscience. 2 sem. hrs.

Fall, Spring and Summer, annually. Prerequisite: None. Bean, Andrew. This course will cover a variety of topics in Molecular Neuroscience. Each semester will emphasize a particular area. Examples of topic areas include development, receptor trafficking, neurotransmitter secretion, olfaction, and synaptic transmission. The objectives of the course are to familiarize students with current research in the topic areas and to teach students effective presentation skills. Weekly meetings (90 minutes) will have both faculty and student presentations drawn from primary literature. Students will be given feed-back on their presentation content and style. This course can be taken multiple times during a student's graduate career.

GS14 1073 Visual Science I. 3 sem. hrs.

Spring, odd-numbered years. Prerequisite: Permission of instructor. Mills, Stephen. Visual Science I is a comprehensive introduction to visual neuroscience and the first steps in vision. The anatomy, physiology, and pharmacology of retinal function will be discussed. Topics will include color vision, neurotransmitters, receptors, ion channels, rod and cone pathways, and adaptation. The course will emphasize phototransduction and retinal circuitry.

GS14 1081 Seminar in Neural Coding and Behavior. 1 sem. hr.

Fall, Spring and Summer, annually. Prerequisite: None. Dragoi, Valentin. It is increasingly being realized that neural systems encode information through the ensemble activity of large populations of neurons. The Seminar in Neural Coding and Behavior will review papers that address how neurons use population codes to represent information via the correlated activity of many neurons. The course will address issues related to information coding by individual neurons, sparse coding schemes, population coding and decoding, and the relationship between the response properties of different brain systems and the natural statistics of their inputs. Finally, the course will discuss how neurons encode and decode information to produce behavioral responses.

GS14 1091 Current Topics in Neural Stem Cell Research. 1 sem. hr.

Fall and Spring, annually. Prerequisites: Basic neuroscience and permission of course coordinator. Majumder, Sadhan. Scientific research on stem cells has opened an exciting new era in biological research and underscored the tremendous potential of stem cells in regenerative medicine and cancer. The objective of this course is to gain an advanced understanding of stem cell biology, with an emphasis on the potential therapeutic application of stem cells for neurodegenerative diseases, such as Alzheimer's disease, Parkinson's disease, and Huntington's disease, and neural cancers such as medulloblastoma and glioma. The introductory lecture by the course coordinator on the basic concepts of stem cell biology will be followed by student presentations and discussions of assigned journal articles intended to illuminate the cutting edge of neural stem cell research. Students will be evaluated based on their presentations, active participation in discussions, and attendance.

GS14 1113 Advanced Topics in Systems Neuroscience. 3 sem. hrs.

Spring, annually. Prerequisites: Neuroscience (GS141017) and Advanced Neurobiology: Cellular and Molecular (GS141103), or permission of instructor. Dragoi, Valentin. This is a lecture and discussion course which explores current issues in the development of the nervous system, changes in structure and function associated with learning and experience, and current issues

in human neurobiology. Topics to be covered include cellular development, sensory and motor systems development and plasticity, learning in vertebrates and invertebrates, and human attention, memory, and emotion.

GS14 1123 Cellular Neuroscience: Biophysical 3 sem. hrs.

Fall, annually. Heidelberger, Ruth and Beierlein, Michael. Prerequisite: Cellular Neurophysiology (GS141143) or equivalent. Permission of instructor. This course provides an upper-level graduate treatment of the biophysics of nerve cell signaling. Topics to be covered include measurement and analysis of single events from ion channels to synaptic vesicle fusion, synaptic transmission and the relationship between calcium signaling and synaptic vesicle dynamics, short-term synaptic plasticity, and postsynaptic integration. Topics will be presented using a combination of didactic lectures and the discussion of original research articles, with much of the emphasis on the latter. This format facilitates a quantitative understanding of the subject matter in the context of experimental design and analysis. In addition, it teaches students how to critically evaluate scientific literature in the field. Class discussions will be held using a journal club format. Each student is expected to present two original research articles. Presentation of additional articles will be moderated by a faculty member. Students should be prepared to discuss salient features of every assigned article. Participation in class discussions will contribute toward a student's final grade.

GS14 1143 Cellular Neurophysiology 3 sem. hrs.

Fall, annually. Prerequisite: consent of the course coordinator. Heidelberger, Ruth. This course is a graduate level treatment of cellular neurophysiology. It is designed for first year students and will provide students with the basic tools for understanding electrical and chemical signaling in the nervous system. Students will learn about topics ranging from bioelectricity to synaptic transmission to plastic changes in synaptic strength that underlie learning and memory. This course is appropriate for students with an interest in neuroscience who are comfortable with the use of mathematical concepts to describe events that occur in the natural world. It is recommended that students have one semester of a calculus-based physical sciences course or one semester of a calculus-based life sciences course prior to taking this course. This course satisfies the GSBS Cellular area breadth requirement.

GS14 1153 Theoretical Neuroscience: Cells, Circuits and Systems 3 sem. hrs.

Fall, annually. Prerequisite: None. Shouval, Harel. This course will cover the biophysical foundations of neuronal cells. It will include a mathematical analysis of ion channels, action potential propagation and generation as well as synaptic transmission. It will also describe reduced neuronal models, models of V1 receptive fields and correlations between different cortical neurons.

GS14 1163 Theoretical Neuroscience: Learning, Perception and Cognition 3 sem. hrs.

Spring, annually. Prerequisite: None. Shouval, Harel. This course develops the synaptic basis of learning and memory which will span from plasticity models to biophysical models of synaptic plasticity; and theoretical systems neuroscience which will include population coding, perception, Bayesian inference and probabilistic models. This course will be taught on the Rice University schedule.

GS14 1173 Introduction to Cognitive Neuroscience. 2 sem. hrs.

Spring, annually. Prerequisite: Approval of the course coordinator. Sereno, Anne. 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 of this course 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.

GS14 1611 Current Topics in Neuroscience. 1 sem. hr.

Fall, annually. Prerequisite: None. Janz, Roger. This course will cover current research topics in Neuroscience at UTHealth, and is intended for first semester students. Through informal weekly discussions with different faculty members, the class will have the opportunity to learn about both the general and specific issues faculty members are trying to answer in their work, the experimental approaches being used, and the progress being made with regard to those issues.

GS14 1181 Graduate Neuroanatomy. 1 sem. hr.

Fall, annually. Prerequisite: None. Beauchamp, Michael. This course will provide a broad overview of the structure and function of the central nervous system. The general architecture of the nervous system and its functional systems are presented in a series of online exercises. The exercises allow the students to examine brain anatomy at a detailed view of the regional anatomy of the brain and spinal cord. MRIs of brain anatomy, as commonly presented in the scientific literature, will be presented using a computerized learning system.

OTHER COURSE OFFERINGS

GS21 1011 Seminars in Clinical Cancer Research. 1 sem. hr.

Fall, annually. Prerequisite: None. Freireich, Emil. This course is designed to extend students' knowledge in the treatment of cancer by examining topics in cancer therapy development. The course will introduce concepts in clinical research trial design including the design of Phase I, II, and III clinical trials. Research ethics, data analysis, and new strategies in clinical trial design such as adaptive randomization will be covered. Finally, a broad overview of cancer biology and innovative treatment strategies will be discussed. Seminars in Clinical Cancer Research is a companion seminar series to Translational Sciences: Bench to Bedside and Back (GS211232) and Translational Cancer Research (GS211613). It is recommended, but not mandatory, that students taking Seminars in Clinical Cancer Research also take Translational Sciences: Bench to Bedside and Back (GS211232) or Translational Cancer Research (GS211613).

GS21 1014 Design and Management of Clinical Trials. 4 sem. hrs.

Fall and Spring, annually. Minimum prerequisite: Bachelor's degree. Buzdar, Aman. This course 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 including imaging, molecular diagnostics, and interactions and monitoring of clinical research laboratories; rules and regulations (including OHRP, FDA, and state), ethics, and human subjects training needed for clinical trials. In addition to 21 hours of lecture, the student will participate in two of three available on-site practicums (Regulatory and Ethical Concepts in Human Subjects Research; Clinical Trial Management; Data Management in Cancer Clinical Trials). Each practicum requires 24 hours of participation.

GS21 1017 Foundations of Biomedical Research. 7 sem. hrs.

Fall, annually. First-year GSBS students only (others by permission of instructor). Schumacher, Jill. 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 topics including genetics, molecular and cellular biology, biochemistry, physiology, developmental biology and biostatistics. This is the Core Course which fulfills the GSBS breadth requirement.

GS21 1018 Foundations of Biomedical Research for Quantitative Students 7 sem. hrs.

Fall, annually. Prerequisite: None, but permission from the GSBS Office of Academic Affairs is required. Enrollment is limited to GSBS first-year and second-year students who will pursue the quantitative degree track. Schumacher, Jill. 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 course will be graded pass/fail and together with Introduction to Biostatistics and Bioinformatics (GS011033) fulfills the GSBS breadth requirement for quantitative-track students.

GS21 1031 Seminars in Clinical Cancer Treatment. 1 sem. hr.

Spring, annually. Prerequisite: None. Freireich, Emil. This seminar course is designed to provide a broad overview of patient-oriented research in oncology. The course will provide a preliminary introduction to the main type of clinical research trials in a variety of modalities such as surgery, radiation, and chemotherapy. The course will focus on specific tumor types and molecular subsets, and examine how new treatment modalities are developed in the clinical setting as well as provide a foundation of knowledge in conventional versus experimental therapy. Issues related to study design, sample size, and translational correlates will also be discussed. Seminars in Clinical Cancer Treatment is a companion seminar series to Human Protocol Research (GS211132). It is recommended, but not mandatory, that students taking Seminars in Clinical Cancer Treatment (GS211031) also take Human Protocol Research (GS211132).

GS21 1041 Topics in Clinical and Translational Research. 1 sem. hr.

Fall and Spring, annually. Prerequisite: None. Norris, Steven. Translational research represents the dynamic interface between basic research and medical practice, in which each field provides vital information to the other. The purpose of this course is to introduce students to the concepts of translational research, and its application to both improved health care and enhanced understanding of biologic processes. In a weekly seminar setting, experts in

a variety of fields (such as microbiology/infectious diseases, cardiac surgery, gene therapy, drug development, and radiology/radiation physics) will present their views of the translational research process, followed by group discussion. Students will prepare brief oral presentations in an area of translational research and discuss them in class.

GS21 1051 The Ethical Dimensions of the Biomedical Sciences. 1 sem. hr.

Fall, annually. Prerequisite: None. This course is required for graduation from all degree programs at GSBS. Seifert, William. This course examines the ethical concepts and traditions that undergird biomedical science. It explores such issues as commitment to truth and its breakdown in self-deception and fraud, the ethics of authorship, biomedical research with human and animal subjects, responsibilities of scientists to society, science's relationship with industry, and the consequences of technologic advances from scientific learning. The course's aim is to teach students to recognize ethical conflicts and problems in their professional lives and to provide a framework within which to analyze and resolve them.

GS21 1052 Introduction to Animal Models. 2 sem. hrs.

Spring, odd-numbered years. Prerequisite: none. Craig, Suzanne. This is an introductory course emphasizing basic principles of laboratory animal care and use. Focus is on basic biology of various laboratory animals, regulations that govern the use of animals in research, alleviation of pain and distress, and facility design. Topics covered include anatomy of various species, experimental surgery, environmental enrichment, pathology and diseases that may occur in laboratory animals.

GS21 1053 Law and Science. 3 sem. hrs.

Spring, annually. Prerequisite: none. Hacker, Carl. This course introduces students with backgrounds largely in the sciences to three areas of law where the application of scientific disciplines continues to grow in importance. These areas include the law of toxic torts, administrative and regulatory law, and patent law. The students will learn how to interpret statutes, regulations, and judicial opinions, and will consider the role of scientists in formulating policy.

GS21 1061 Critical Thinking in Science. 1 sem. hr.

Summer, annually. Prerequisites: general knowledge of biology or biomedicine. Mattox, William. In this course students will develop skills for critically and professionally evaluating the significance, logic and presentation of scientific studies. Class sessions will emphasize student discussion and debate of topics including experimental design, the logical interpretation of results, scientific fraud, controversial results, dogma, and effective critique. Through class exercises students will gain understanding of the peer review process and will develop skills required to write critiques of manuscripts and research proposals.

GS21 1093 Topics in Translational Biomedical Engineering. 3 sem. hrs

Spring,, annually. Prerequisite: none. Mathur, Anshu. This course is designed to address applications of engineering methods and technologies for translation into medicine with animal models such that translation is emphasized. The emphasis areas include: Cellular Interface of Biomaterials and Devices in Clinically translatable In vivo Systems, Repair and Regeneration of

Tissues, Cancer Cells and Therapeutic Targeting, Nanotechnology and Applied Nanomedicine, Cell and Tissue Detection Devices and Applications, Transfer of Device Technology Pathway and FDA approval. Faculty members are invited from various disciplines from MDACC, UTHealth, and Rice University to lecture about their research expertise area and discuss.

GS21 1102 Ethics in Clinical Trials Research. 2 sem. hrs

Fall, annually. Prerequisite: none. Hong, David. This course explores and examines the ethical issues central to clinical trials research. It will provide an overview of ethics in clinical research and is designed for investigators who will be conducting research on human subjects. Students will learn the historical background, current regulations, and promote an understanding of the function and procedures of Institution Review Boards requirements related to human subjects protection issues and better appreciation of the role of good clinical research for clinical trials. The course's aim is to teach students to recognize ethical conflicts and problems in their professional lives and to provide a framework within which to analyze and resolve them. Topics will cover the discussion of principles of bioethics and how these principles should be applied to the ethical conduct of human subject research, balancing the benefits and harms of participation in stem cell research and ethical issues in the selection of research participants.

GS21 1111 Statistical Genetics Journal Club. 1 sem. hr.

Fall and Spring, annually. Prerequisite: None; recommended concurrent graduate course in statistics and genetics. Scheet, Paul. 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.

GS21 1112 Bio-behavioral Research Methods in Cancer Prevention and Addiction. 1 sem. hr.

Spring, even-numbered years. Prerequisite: None. Chang, Shine, coordinator; Cameron, Carrie, co-coordinator. This course 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.

GS21 1121 Resources and Methods for Analysis of Patient-Derived Samples. 1 sem. hr.

Summer, annually. Prerequisite: None. Kopetz, Scott. This course will provide the knowledge needed for the practical application of patient-oriented biological research. Over ten weeks, students will receive training on how to obtain, prepare, analyze, and interpret patient samples for research purposes. Students will attend ten 90-minute sessions in which lecturers with expertise in each topic will be educate them on the resources available at the institution, potential pitfalls, practical limitations, costs, and contacts for help.

GS21 1122 Introduction to Large Animal Models. 2 sem. hrs.

Summer, annually. Craig, Suzanne. Prerequisite: None. This is an introductory course emphasizing basic principles of laboratory animal care and use. Focus is on basic biology of large laboratory animals such as non-human primates, sheep, pigs, rabbits and dogs, regulations that govern the use of these animals in research, alleviation of pain and distress and facility design. Topics covered include anatomy of various species, experimental surgery, environmental enrichment, pathology and diseases that may occur in laboratory animals.

GS21 1132 Human Protocol Research. 2 sem. hrs.

Spring, annually. Prerequisite: None. Janku, Filip. Human Protocol Research is an integrated, multidisciplinary course designed to provide students the necessary tools to devise, execute, and understand exemplary protocol research involving humans in clinical trials. Phase 0, I, II, III and IV trials will be discussed. Students participating in this course will gain an understanding of trial design, sample size and ethical/regulatory issues pertaining to clinical trials. The course is complementary and non-overlapping with Translational Sciences: Bench to the Bedside and Back (GS211232). Seminars in Clinical Cancer Treatment (GS211031) is a companion seminar series to Human Protocol Research. It is recommended, but not mandatory, that students taking Human Protocol Research also take Seminars in Clinical Cancer Treatment (GS211031).

GS21 1142 Writing Scientific Research Articles for Publication. 2 sem. hrs.

Summer, annually. Prerequisite: Consent of Instructor. Picus, Mark. 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.

GS21 1151 Science Writing

1 sem. hr.

Spring, annually. Prerequisite: None. Bean, Andrew. The objectives of the course are to teach critical thinking and the fundamentals of proposal writing that will help students write papers, meeting abstracts, candidacy exam proposals, grants, and their theses/ dissertations. Weekly meetings (90 minutes) will have short student presentations drawn from primary literature, but the major focus will be working on grant proposals. Students will be given feedback on their presentation content/style and the papers presented will be used as the basis for weekly writing assignments. Each student will ultimately generate a scientific grant proposal based on one of the presented papers with input from faculty, TA's, and students. This course fulfills the GSBS Science Writing requirement.

GS21 1232 Translational Sciences: Bedside to

2 sem. hrs

Bench and Back.

Fall, annually. Prerequisite: None. Kopetz, Scott. Translational Research 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.

GS21 1611 Topics in Molecular Medicine (P/F Only).

1 sem. hr.

Fall, Spring, and Summer, annually. Prerequisite: Permission of instructor. Milewicz, Dianna. 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.

GS21 1613 Translational Cancer Research.

3 sem. hrs.

Spring, annually. Prerequisite: Cancer Biology (GS041063) preferred. Bast, Robert. 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.

GS21 1622 Topics in Cancer Prevention Research.

2 sem. hrs.

Spring, odd-numbered years. Prerequisite: None. Chang, Shine; Cameron, Carrie. 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.

MEMBERS OF THE FACULTY

The following is a roster of the nearly 600 active members of the GSBS Faculty. The first line of each entry includes the faculty member's institution of primary appointment; the following abbreviations are employed:

For the institutions of The University of Texas Health Science Center at Houston:

UTHealth-GSBS	Graduate School of Biomedical Sciences
UTHealth-MS	Medical School
UTHealth-SBMI	School of Biomedical Informatics
UTHealth-SOD	School of Dentistry
UTHealth-SPH	School of Public Health
UTHealth-G	Health Science Center-General Administration

For The University of Texas MD Anderson Cancer Center: MDACC

For Texas A&M University-Institute of Biosciences and Technology: TAMU-IBT

A more complete description of the faculty's current research activities and publications, together with the projects available to students in their laboratories, may be obtained from the GSBS website.

Regular Members

Christian R. Abee, Veterinary Sciences, MDACC. D.V.M., Texas A&M University, 1971

Jeffrey K. Actor, Pathology & Laboratory Medicine, UTHealth-MS. Ph.D., University of Massachusetts, 1991.

Gheath Al-Atrash, Stem Cell Transplantation & Cellular Therapy, MDACC. D.O., Ph.D., University of North Texas Health Science Center, 2002.

Joseph L. Alcorn, Jr., Pediatrics, UTHealth-MS. Ph.D., University of Texas at Dallas, 1988.

Kenneth Aldape, Pathology, MDACC. M.D., University of California-San Francisco, 1991.

C. Marcelo Aldaz, Molecular Carcinogenesis, MDACC. M.D., University of Buenos Aires, 1980.

James P. Allison, Immunology, MDACC. Ph.D., University of Texas at Austin, 1974.

Hesham M. Amin, Hematopathology, MDACC. M.D., Cairo University Faculty of Medicine, 1982.

Zhiqiang An, IMM, UTHealth-MS. Ph.D., University of Kentucky, 1991.

Michael Andreeff, Leukemia, MDACC. M.D., University of Heidelberg Medical School, 1968; Ph.D., University of Heidelberg Medical Faculty, 1976.

Cesar A. Arias, Internal Medicine-Infectious Diseases, UTHealth-MS. M.D., Universidad El Bosque, 1992; Ph.D., University of Cambridge, 2000.

Ralph B. Arlinghaus, Molecular Pathology, MDACC. Ph.D., University of Cincinnati College of Medicine, 1961.

Jaroslawn A. Aronowski, Neurology, UTHealth-MS. Ph.D., Polish Academy of Sciences, 1992.

Banu Arun, Breast Medical Oncology and Clinical Cancer Prevention, MDACC. M.D., University of Istanbul Medical School, 1990

Swathi Arur, Genetics, MDACC. Ph.D., All India Institute for Medical Sciences, 2002.

Keith A. Baggerly, Bioinformatics & Computational Biology, MDACC. Ph.D., Rice University, 1994.

Veerabhadran Baladandayuthapani, Biostatistics, MDACC. Ph.D., Texas A&M University, 2005.

James A. Bankson, Radiation Physics, MDACC. Ph.D., Texas A&M University, 2001.

Menashe Bar-Eli, Cancer Biology, MDACC. Ph.D., Hebrew University, 1978.

Chandra Bartholomeusz, Breast Medical Oncology, MDACC. M.D., University of Zambia, 1986; Ph.D., UTHealth GSBS, 2004.

Blaine Bartholomew, Molecular Carcinogenesis, MDACC. Ph.D., University of California, Davis, 1988.

Michelle C. Barton, Biochemistry & Molecular Biology, MDACC. Ph.D., University of Illinois, 1989.

Robert C. Bast, Jr., Experimental Therapeutics, MDACC. M.D., Harvard Medical School, 1971.

Andrew J. Bean, Neurobiology & Anatomy, UTHealth-MS. Ph.D., Yale University, 1990.

Michael S. Beauchamp, Neurobiology & Anatomy, UTHealth-MS. Ph.D., University of California, 1997.

Sam Beddar, Radiation Physics, MDACC. Ph.D., University of Wisconsin, 1990.

Mark Bedford, Molecular Carcinogenesis, MDACC. Ph.D., Weizmann Institute of Science, 1996.

Richard R. Behringer, Genetics, MDACC. Ph.D., University of South Carolina, 1986.

Michael Beierlein, Neurobiology & Anatomy, UTHealth-MS. Ph.D., Brown University 2000.

Jennifer E. "Piper" Below, Epidemiology & Disease Control, UTHealth-SPH. Ph.D., University of Chicago, 2011.

Rebecca Berdeaux, Integrative Biology & Pharmacology, UTHealth-MS. University of California at Berkeley, 2003.

Laura Beretta, Molecular & Cellular Oncology, MDACC. Ph.D., University of Paris 6, 1989.

Chantale Bernatchez, Melanoma Medical Oncology, MDACC. Ph.D., Laval University, 2004.

Elmer V. Bernstam, UTHealth-SBMI. M.D., University of Michigan, 1995.

Donald A. Berry, Quantitative Sciences, MDACC. Ph.D., Yale University, 1971.

Michael R. Blackburn, Biochemistry & Molecular Biology, UTHealth-MS. Ph.D., Thomas Jefferson University, 1993.

Darren F. Boehning, Biochemistry & Molecular Biology, UTHealth-MS. Ph.D., Thomas Jefferson University, 2001.

Eric A. Boerwinkle, Epidemiology & Disease Control, UTHealth-SPH & IMM, UTHealth-MS. Ph.D., University of Michigan, Ann Arbor, 1985.

Oliver Bögl, Neurosurgery, MDACC. Ph.D., Ludwig Institute for Cancer Research, 1991.

Richard R. Bouchard, Imaging Physics, MDACC. Ph.D., Duke University, 2010.

Douglas Boyd, Cancer Biology, MDACC. Ph.D., Edinburgh University, 1985.

Shawn B. Bratton, Molecular Carcinogenesis, MDACC. Ph.D., University of Texas at Austin, 1999.

Ghislain Breton, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., University of Quebec, Montreal, 2004.

Russell R. Broaddus, Pathology, MDACC. M.D., Ph.D., UTHealth-MS, UTHealth-GSBS, 1994.

Powel H. Brown, Clinical Cancer Prevention, MDACC. Ph.D., New York University, 1984; M.D., New York University, 1985.

Nathan S. Bryan, IMM, UTHealth-MS. Ph.D., Louisiana State University School of Medicine, 2004.

L. Maximilian Buja, Pathology & Laboratory Medicine, UTHealth-MS. M.D., Tulane University School of Medicine, 1967.

Jan A. Burger, Leukemia, MDACC. M.D., Ph.D., Albert Ludwigs University School of Medicine, 1994.

Lauren A. Byers, Thoracic/Head & Neck Medical Oncology, MDACC. M.D., Baylor College of Medicine, 2003.

John H. Byrne, Neurobiology & Anatomy, UTHealth-MS. Ph.D., Polytechnic Institute of Brooklyn, 1973.

Fernando R. Cabral, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., University of Rochester, 1973.

George A. Calin, Experimental Therapeutics, MDACC. M.D., "Carol Davila" University of

Medicine and Pharmacy (Romania), 1992; Ph.D., "Carol Davila" University of Medicine and Pharmacy (Romania), 2000.

Wei Cao, Immunology, MDACC. Ph.D., University of North Carolina at Chapel Hill, 1995.

Phillip B. Carpenter, Biochemistry & Molecular Biology, UTHealth-MS. Ph.D., University of Illinois at Urbana-Champaign, 1994.

Joya Chandra, Pediatrics, MDACC. Ph.D., UTHealth-GSBS, 1998.

Jeffrey T. Chang, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., Stanford University, 2004.

Shine Chang, Epidemiology, MDACC. Ph.D., University of North Carolina-Chapel Hill, 1995

Jichao Chen, Pulmonary Medicine, MDACC. Ph.D., Johns Hopkins University School of Medicine, 2006.

Junjie Chen, Experimental Radiation Oncology, MDACC. Ph.D., University of Vermont, 1993.

Ken Chen, Bioinformatics & Computational Biology, MDACC. Ph.D., University of Illinois at Urbana-Champaign, 2004.

Taipng Chen, Molecular Carcinogenesis, MDACC. Ph.D., McGill University, 2000.

Zheng (Jake) Chen, Biochemistry & Molecular Biology, UTHealth-MS. Ph.D., Columbia University, 2003.

Xiaodong Cheng, Integrative Biology and Pharmacology, UTHealth-MS. Ph.D., University of Texas Medical Branch, 1994.

Paul J. Chiao, Molecular and Cellular Oncology, MDACC. Ph.D., UTHealth-GSBS, 1991.

Lynda Chin, Genomic Medicine, MDACC. M.D., Albert Einstein College of Medicine, 1993.

Raymond Cho, Psychiatry and Behavioral Sciences, UTHealth-MS. M.D., University of Toronto, 1993.

Sang Hyun Cho, Radiation Physics & Imaging Physics, MDACC. Ph.D., Texas A&M University, 1997.

Peter J. Christie, Microbiology & Molecular Genetics, UTHealth-MS. Ph.D., Cornell University, 1986.

Francois X. Claret, Systems Biology, MDACC. Ph.D., University of Lausanne, 1993.

Leonard J. Cleary, Jr., Neurobiology & Anatomy, UTHealth-MS. Ph.D., Columbia University, 1984.

Dianna D. Cody, Imaging Physics, MDACC. Ph.D., University of Michigan, 1987.

Francesca Cole, Molecular Carcinogenesis, MDACC. Ph.D., Mount Sinai School of Medicine of New York University, 2003.

Laurence J. N. Cooper, Pediatrics, MDACC. Ph.D., Case Western Reserve University, 1993; M.D., Case Western Reserve University, 1994.

Gilbert J. Cote, Endocrine Neoplasia & Hormonal Disorders-Research, MDACC. Ph.D., University of Vermont, 1987.

Laurence E. Court, Radiation Physics, MDACC. Ph.D., University of London, 1995.

Shane R. Cunha, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., Northwestern University, 2002.

Michael A. Curran, Immunology, MDACC. Ph.D., Stanford University Medical School, 2001.

Nachum Dafny, Neurobiology & Anatomy, UTHealth-MS. Ph.D., Hadassah Medical School, 1968.

Stephen P. Daiger, Epidemiology, Human Genetics & Environmental Sciences, UTHealth-SPH. Ph.D., Stanford University, 1976.

Robert Dantzer, Symptom Research, MDACC. D.V.M., University Paul Sabatier, 1967; Ph.D., University Paul Sabatier, 1977.

Pramod Dash, Neurobiology & Anatomy, UTHealth-MS. Ph.D., Carnegie-Mellon University, 1986.

Michael A. Davies, Melanoma Medical Oncology and Systems Biology, MDACC. M.D., Ph.D., UTHealth-MS and UTHealth GSBS, 2001.

Brian R. Davis, IMM, UTHealth-MS. Ph.D., California Institute of Technology, 1980.

R. Eric Davis, Lymphoma & Myeloma, MDACC. M.D., Medical University of South Carolina, 1984.

Nicholas R. De Lay, Microbiology & Molecular Genetics, UTHealth-MS. Ph.D., University of Illinois at Urbana-Champaign, 2007.

Catherine Denicourt, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., University of Montreal, 2003.

Sharon Y.R. Dent, Molecular Carcinogenesis, MDACC. Ph.D., Rice University, 1986.

Ronald A. DePinho, Cancer Biology, MDACC. M.D., Albert Einstein College of Medicine, 1981.

Carmen W. Dessauer, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., Louisiana State University, 1993.

Burton Dickey, Pulmonary Medicine, MDACC. M.D., University of Connecticut, 1980.

Ethan Dmitrovsky, Thoracic/Head & Neck Medical Oncology and Cancer Biology, MDACC. M.D., Cornell University Medical College, 1980.

Kim-Anh Do, Biostatistics, MDACC. Ph.D., Stanford University, 1990.

Chen Dong, Immunology, MDACC. Ph.D., University of Alabama at Birmingham, 1996.

Patrick M. Dougherty, Anesthesiology and Pain Medicine, MDACC. Ph.D., UTHealth-GSBS, 1988.

William Dowhan, Biochemistry & Molecular Biology, UTHealth-MS. Ph.D., University of California at Berkeley, 1969.

Valentin Dragoi, Neurobiology & Anatomy, UTHealth-MS. Ph.D., Duke University, 1997.

Giulio F. Draetta, Genomic Medicine, MDACC. M.D., University of Naples Medical School, 1981; Ph.D., University of Naples Medical School, 1985.

Guangwei Du, Integrative Biology & Pharmacology, UTHealth-MS. Ph.D., Peking Union Medical College, 1999.

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