

# BIOLOGICAL AND BIOMEDICAL SCIENCES

## Programs

- Biological and Biomedical Sciences, Master of Science (<https://catalog.hbku.edu.qa/academic-degrees/chls/bbs/bbs-ms/>)
- Biological and Biomedical Sciences, PhD (<https://catalog.hbku.edu.qa/academic-degrees/chls/bbs/bbs-phd/>)
- Biopsychology and Neuroscience, Phd (<https://catalog.hbku.edu.qa/academic-degrees/chls/bbs/phd-bns/>)

## Division Courses

### Core Life Sciences

**CLS 600 Techniques in Biochemistry** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

This course is designed to train students in a range of standard biochemical and cellular biology techniques that are in routine use in a functioning biochemistry laboratory. The course combines lectures illustrating the scientific principles underlying a particular technique with hands-on experience of the methodology in the laboratory. Techniques include protein expression, purification, gel analysis, protein structure and cell culture.

**CLS 625 Applied Biostatistics** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

The aim of this course is to introduce the fundamental biostatistical concepts to life science students. It aims to give an overview of the statistical and computational ideas required for analysis methods in biological sciences, and provide hands-on experience in analysis. This course does not assume that the student has a background in mathematics and computer science, but introduces all necessary background during the course. The course is appropriate for graduate students and researchers in health and life sciences.

**CLS 661 Special Topics in Biosensors** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

Over the past 20 years, the field of bio-sensing technology has had a profound impact on both laboratory research as well as commercial activities. With the advance of semiconductor and nanofabrication technologies, bio-technological application-specific integrated circuits (ASICs) have become a major trend in research as well as industry. Examples include DNA sensing, microelectrode measurement array systems for in-vitro and in-vivo physiological research at the cellular level. Bio-sensing has had a major impact on different fields including, E-health systems, genome research and drug development.

**CLS 706 Independent Studies** **3 Credits**  
Grade Mode: Standard Letter

Independent Studies allow students to examine a variety of timely, cutting-edge research areas in life sciences. Taught by our faculty, research scientists from our research institutes or associated industries, this course allows students to keep up with novel trends and topics in the field.

**CLS 711 Development and Diseases of The Nervous System** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

The aim of the course is to unfold the processes that underlie the formation and disorders the nervous system at the molecular, cellular and circuitry levels. The course will focus on genes/proteins and signaling pathways involved in neural induction, neural tube closure, patterning of the nervous system, neurogenesis, neuronal migration, axon pathfinding, as well as formation and refinement of synapses. Both physiological and pathological conditions will be addressed.

**CLS 726 Proteomics in Precision Medicine** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

Personalized medicine has revolutionized the medical practice, and to achieve its goals today we are not only dependent on genomics but also on the proteomics for accurate diagnosis and efficient treatments. Thus, there is a growing demand for proteomics-based learning and applications in the field of basic and clinical research. The course 'Proteomics in precision medicine' will bridge this knowledge gap in the GPM program by teaching the students key concepts of proteomics and the overall applications and limitations.

**CLS 751 Molecular Mechanisms of Cancer and Their Applications** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

This course will introduce students to the molecular mechanisms that lead to cancer development. It will describe the methods used to study these mechanisms and how they can be exploited in cancer diagnostics and therapy.

### Life Sciences

**LS 601 Research Methods and Ethics** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

This course is a foundational course for graduate students who will be engaged in research with a focus on health sciences and precision medicine. It provides students with advanced discussions on ethics and ethical misconduct, intellectual property and environmental health and safety as well as scientific thought and design of experiments. A focus of the course is to transition students from textbooks to primary literature as their main source of information.

**LS 603 Advanced Molecular Biology** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

This course covers the important principles in Molecular Biology, including the replication of DNA, how DNA is converted to RNA, how RNA is modified, transported and regulated, and finally how it is converted to protein. Through the use of primary literature papers, students will gain a current understanding of these subjects.

**LS 605 Advanced Cell Biology** **3 Credits**  
Grade Mode: Standard Letter, Audit/Non Audit

This course builds on the knowledge students acquired in Advanced Molecular Biology and covers the important principles of Cell Biology, the study of the basic unit of life. By relying heavily on recently published seminal scientific papers, students will acquire an accurate understanding of the current research progress in key areas in cell biology.

**LS 607 Advanced Human Physiology 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course focuses on how the human body functions as an integrated system in which cells, tissues, and organs interact to maintain a healthy body. It covers the anatomy and physiology of cardiovascular, respiratory, muscle, renal, gut and endocrine systems. The course also highlights the pathophysiology of some disease conditions.

**LS 695 Master's Thesis Hours 0-6 Credits**

Grade Mode: Pass/Non Pass

Full time work in a laboratory to perform experiments related to the MS Thesis dissertation. Thesis research is an essential component of the graduate degree in Biological and Biomedical Sciences at HBKU. All students are required to engage in thesis research.

**LS 701 Research Seminar 0 Credits**

Grade Mode: Pass/Non Pass

The HBKU Life Science Seminar Series engages students, local researchers, and scientists to catalyze information exchange and networking among researchers for the advancement of life science research in Qatar.

**LS 704 Metabolism and drug discovery 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

The course will provide an in-depth analysis of the relationships between metabolism and important human diseases. It will focus on the pathways of intermediary metabolism by which all cells synthesize and degrade carbohydrates, lipids (fats), and proteins; and discuss how these pathways are regulated by effector molecules and hormones, and how this can be translated into drug design and development. Emphasis will be on how obesity, diabetes, cardiovascular disease, metabolic syndrome, and defects in metabolic pathways lead to cancer.

**LS 708 Advanced Neuroscience 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This graduate course will provide knowledge on fundamental principles that encompass the multidisciplinary field of neuroscience. This will include basic principles of membrane excitability, neuronal information transfer and storage, neuropharmacology, neurodevelopment, sensory systems physiology, behavior and clinical manifestations. Focus on each of these topic areas will include interactive lectures together with development of critical thinking via review and discussion of recent scientific articles that are advancing the field. The course material encompasses molecular, cellular tissue and systems level physiology in each of the sub-discipline areas. Emphasis will be on providing a solid foundation in basic principles to prepare those conducting research in neuroscience to implement the transdisciplinary information in innovative ways.

**LS 709 Molecular and Cellular Biology of Neurodegenerative Diseases 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course will engage students in a detailed exploration of the most important neurological disorders, including Alzheimer's disease (AD), Parkinson's disease (PD), Huntington's disease (HD) and prion diseases. With an initial focus on clinical descriptions for each condition, an in-depth discussion on current hypotheses about the mechanisms underlying these diseases will constitute the bulk of this course.

**LS 710 Cancer Biology 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course covers advanced concepts in cancer biology. The course begins with a focus on the cell death pathways, transformation of normal to cancer cells and subcellular changes within cancer cells, including non-coding RNA and epigenetic changes. It then covers the cancer cell environment and how cells metastasize. There is a special focus on how the immune system interacts with cancer cells. Finally, the course will present important tools for cancer research and anti-cancer drug development.

**LS 712 Cancer Immunology 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

Cancer Immunotherapy was selected by "Science" journal as the breakthrough of the year for 2013, which placed it in the company of the first cloned mammal and the complete sequencing of the human genome. Cancer immunology is now one of the most active areas of cancer research and has prompted the development of several important novel therapies currently in use, including cytokine-based therapies, vaccine therapies, and monoclonal antibody therapies. It aims to understand the interaction between immune system and cancer cells, and to discover innovative cancer immunotherapies to treat and retard progression of the disease. This course covers the important aspects of cancer immunology including immune surveillance/editing theory, immune evasion, immunopathogenesis of cancer and tumor antigens. In addition, the different immunotherapeutic approaches of cancer, including T-cell therapy, antibody-based therapies and cancer vaccines will be covered.

**LS 713 Behavior, Learning and Memory 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course will provide the knowledge on multidisciplinary field of neuroscience and build the foundation for understanding the biological basis of behavior, learning and memory. This course will cover the perspectives, questions, and techniques related to neural and molecular systems responsible for behavior, learning, memory, emotions, consciousness and neurodevelopmental basis of behaviors like addiction, fear and anxiety and Alzheimer's disease. Students will learn neuroanatomy, and how the activity of few neurons can yield simple motor action and complex behavioral/psychological functions such as learning and memory.

**LS 714 Scientific Communication and Professional Development 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course will cover key concepts in effective scientific communication, both written and oral. It will also address aspects of CV and cover letter preparation for academia and industry. In addition, it will provide the skills needed in mentoring, establishing collaborations and getting funded in academia.

**LS 715 Physiopathological Mechanisms of Neurogenetic Diseases 3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course is intended for graduate students interested in gaining a detailed understanding of molecular mechanisms underlying physiopathological mechanism of genetic diseases related to synapses and muscles. Throughout the course, the focus will be on understanding the experimental approaches that produced current knowledge. Students will be assigned recent research papers as their primary reading materials. About 2/3 of the classes will be lectures by the instructor and 1/3 will be student led discussions of papers.

**LS 730 Mechanobiology in Health and Disease****3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

Prerequisite(s): LS 605

This course covers key principles in mechanobiology, the study of how mechanical environment and cues affect cellular behavior, and how these signals are communicated through mechanotransduction. This course will focus on our most up-to-date understanding of this rapidly growing area of biology and rely heavily on recently published seminal publications.

**LS 740 Stem Cell Biology****3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course is intended as an introduction and in-depth discussion focused on the biology of stem cells. The course will introduce the features of stem cells and basic mechanisms regulating their self-renewal and pluripotency. In addition, the course will focus on selected examples of adult stem cells with an introduction to translational medicine approaches involving stem cell biology. Major emphasis will be placed on how advances in stem cell biology and tissue engineering can be applied to the use of embryonic and adult stem cells in regenerative medicine. In addition to these topics, students will be introduced to the ethical, regulatory, and legal issues related to stem cell research.

**LS 741 Signal Transduction in Health and Diseases****3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

The course will engage students in the concepts of signal transduction, and how the signaling pathways drive different physiological as well as pathological conditions such as diabetes, cancer, and neurological disorders.

**LS 742 Advances in Human Metabolism and Disease****3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

The course will provide an in-depth analysis of the relationships between metabolism and important human diseases. It will focus on the pathways of intermediary metabolism by which all cells synthesize and degrade carbohydrates, lipids (fats) and proteins; and discuss how these pathways are regulated by effector molecules and by hormones in living systems. Much of the emphasis will be on how several human disorders such as obesity, diabetes, cardiovascular disease, the metabolic syndrome and cancer arise from defects in metabolic pathways.

**LS 751 Immunology and Immunogenomics****3 Credits**

Grade Mode: Standard Letter, Audit/Non Audit

This course addresses important concepts in immunology and gives students a broad knowledge base from which they can continue to learn advanced concepts and pursue research in any aspect within the field. The course also covers concepts in immunogenetics including how genetic defects affect immune responses, resulting in diverse phenotypes or consequences. The course will start with lectures 2 hours a week to teach fundamental concepts, then continue starting week 9 with 5 hours/week of hands-on training/practical on experimental methods/tools in immunology as well as student journal club presentations. Lastly, the course will conclude with a workshop on immunogenetics and inborn errors of immunity by guest lecturers from IMAGINE Institute, Paris, France. The course assumes basic knowledge of cell and molecular biology.

**LS 890 Dissertation Hours****0-9 Credits**

Grade Mode: Pass/Non Pass

Full time work in a laboratory to perform experiments related to the PhD Thesis dissertation. Thesis research is an essential component of the graduate degree in Biological and Biomedical Sciences at HBKU. All students are required to engage in thesis research.