Clinical Laboratory Sciences

The mission of the Department of Clinical Laboratory Sciences is to provide undergraduate and graduate programs in which qualified students can prepare themselves for careers in the clinical laboratory sciences and molecular biotechnology. The department is responsive to current workforce needs in health care and life science systems, and provides leadership in developing programs to meet those needs.

Located at the region's premier academic health center, the Department of Clinical Laboratory Sciences is a part of the School of Health Professions (http://healthprofessions.kumc.edu) on the Medical Center campus of the University of Kansas. KU Medical Center (http://www.kumc.edu) is located in the heart of the Kansas City metropolitan area at 39th and Rainbow Boulevard – about 40 minutes away from the main KU campus (http://www.ku.edu) in Lawrence, Kansas.

To support its missions, the Department of Clinical Laboratory Sciences offers the following degree programs:

**Bachelor of Science in Clinical Laboratory Science**

This four-year, entry-level degree is for those with an interest in performing diagnostic testing on blood, bodily fluids, and other human specimens. The BS in CLS is available in two options: (i) the Clinical Concentration which is an accredited Medical Laboratory Science (MLS) program, or (ii) the Molecular Biotechnology Concentration which is an accredited Diagnostic Molecular Scientist (DMS) program. Students are also offered the option of completing both the MLS and DMS programs by adding an additional semester of study. The MLS and DMS programs are accredited by the National Accrediting Agency for Clinical Laboratory Sciences (http://www.naaccls.org), 5600 N. River Road, Suite 720, Rosemont, IL 60018, 773-714-8880.

**Master of Science in Molecular Biotechnology**

A two-year, non-thesis program, this graduate-level degree prepares students for research careers in molecular biotechnology-oriented clinical, industrial and basic science laboratories. Students obtain training in the use and application of cutting edge molecular-based methodologies and instrumentation as well as critical thinking, trouble shooting, and communication skills.

**Doctorate in Clinical Laboratory Science**

The doctorate program allows practicing, certified medical laboratory scientists the opportunity for advanced practice and training at the highest level. Besides providing career advancement opportunities, the DCLS graduate will be able to institutionalize new models of clinical consultation to clinicians, other health care providers, and patients to guide their decisions about utilization of laboratory tests or services. This three-year program includes two years of core curriculum courses and one year of clinical residency, if completed on a full-time basis (part-time options are available).

**Advising and FAQ**

For information about clinical laboratory science at KU, please visit the department’s website (http://cls.kumc.edu). Students interested in entering these programs should contact an advisor as early as possible to ensure prerequisite course work will be completed. Advising and campus visits are available Monday-Friday by appointment. Please email clsed@kumc.edu for information. For advising on the KU Lawrence campus, please see the KU Undergraduate Advising Center (http://advising.ku.edu).

**Courses**

**CLS 210. Introduction to Clinical Laboratory Sciences. 1 Hour.**

An introductory overview of the professions of Clinical Laboratory Sciences and Cytotechnology including types of analyses performed, specialties, interrelationships in the health care system and a visit to a clinical laboratory. This course will enable those considering a major in the Clinical Laboratory Sciences to have a clear definition of the professions. (Same as BIOL 210.) LEC.

**CLS 520. Phlebotomy. 1 Hour.**

Principles and practice of collecting blood specimens for clinical laboratory analyses. Includes specimen identification, equipment, anticoagulants, safety precautions, specimen transport, and processing. Hepatitis immunization required. Prerequisite: Admission to the Clinical Laboratory Science Program or consent of instructor. LAB.

**CLS 523. Fundamentals of Analytical Techniques Laboratory. 3 Hours.**

Student laboratory with recitation addressing techniques and methodologies used in the clinical laboratory. Laboratory skills include laboratory math, quality control, pipetting, and instrumentation used in analysis of body fluids. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LAB.

**CLS 530. Clinical Chemistry I. 3 Hours.**

Introduction to human physiology and pathophysiology I with emphasis on proteins, carbohydrates, lipids, enzymes, liver kidney function, blood gases and body fluids. The related clinical chemistry tests, their principles, analysis, interpretation, and significance are included. Prerequisite: CLS 523 or consent of instructor. LEC.

**CLS 532. Clinical Microbiology I. 3 Hours.**

Pathogenesis and disease processes of pathogenic, opportunistic, and saprophytic bacteria; composition and preparation of media; sterilization and disinfection; antimicrobial agents and susceptibility testing; topics related to theory and applications. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LEC.

**CLS 533. Clinical Microbiology I Laboratory. 2 Hours.**

A laboratory with recitation addressing diagnostic procedures used for isolation and identification of clinically significant bacteria. Prerequisite: CLS 532 or CLS 532 concurrently, or consent of the instructor. LAB.

**CLS 536. Hematology I. 3 Hours.**

Fundamentals of hematopoiesis; the physiology, function, and cytochemistry of normal and abnormal blood cells; the theory and performance of clinical laboratory methods related to these parameters. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LEC.

**CLS 537. Hematology I Laboratory. 2 Hours.**

A laboratory with recitation emphasizing basic hematologic techniques and identification of normal and abnormal cells in peripheral blood and bone marrow. Prerequisite: CLS 536, or CLS 536 concurrently, or consent of the instructor. LAB.

**CLS 538. Immunoology. 3 Hours.**

Covers basic theory of molecular and cellular immunology of innate and adaptive immune systems. Lectures include: structure and function of
antibodies, complement, major histocompatibility complexes, B- and T-cells and their receptors, cellular and molecular basis of the immune response and immune regulation, hypersensitivity, and immune tolerance. Clinical applications and methodologies will be incorporated into lectures. Prerequisite: Admission to the Department of Clinical Laboratory Sciences or consent of instructor. LEC.

CLS 540. Clinical Chemistry II. 2 Hours.
Introduction to human physiology and pathophysiology II with emphasis on hormones, therapeutic drugs, clinical toxicology, tumor markers, vitamins and trace elements. The related clinical chemistry tests, their principles, analysis, interpretation, and significance are included. Prerequisite: CLS 530 or consent of instructor. LEC.

CLS 541. Professional Development. 2 Hours.
This course combines lectures and projects to give students an introduction to and practice in the following: resume writing and interviewing skills; the components of and the production of a scholarly product; the basic principles involved in education with the identification and writing of educational objectives; the activities and responsibilities involved in laboratory management. Prerequisite: CLS 520 - CLS 549 or consent of instructor. LEC.

CLS 542. Clinical Microbiology II. 2 Hours.
Pathogenesis, disease processes, and diagnostic protocols for parasites, medically important fungi and mycobacteria. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LEC.

CLS 543. Clinical Microbiology II Laboratory. 2 Hours.
A laboratory with recitation addressing diagnostic procedures used for isolation and identification of parasites, medically important fungi, and mycobacteria. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LAB.

CLS 544. Immunohematology I. 3 Hours.
Principles of immunohematology as applied to transfusion services, donor services, component preparation and storage, and transfusion therapy. Includes problem solving for transfusion related situations and evaluation of problems related to hemolytic disease of the newborn, autoimmune hemolytic disorders, and transfusion reactions. Prerequisite: BIOL 503 or CLS 538, CLS 546, or consent of instructor. LEC.

CLS 545. Immunohematology I Laboratory. 2 Hours.
Principles of immunohematology as applied to transfusion services, donor services, component preparation and storage, and transfusion therapy. Includes problem solving for transfusion related situations and evaluation of problems related to hemolytic disease of the newborn, autoimmune hemolytic disorders, and transfusion reactions. Prerequisite: BIOL 503 or CLS 538, CLS 546, or consent of instructor. LAB.

CLS 546. Hematology II. 3 Hours.
Lectures on hematopoiesis, the physiology, function, and cytochemistry of normal and abnormal blood cells, normal and abnormal hemostasis, and the theory and performance of laboratory methods related to these parameters. Prerequisite: CLS 536 and CLS 537 or consent of instructor. LEC.

CLS 547. Hematology II Laboratory. 2 Hours.
A laboratory with recitation involving performance of hematology laboratory procedures with emphasis on basic hematologic and coagulation techniques and the identification of normal and abnormal cells in the peripheral blood and bone marrow. Prerequisite: CLS 536, CLS 537 and CLS 546 or CLS 546 concurrently, or consent of the instructor. LAB.

CLS 549. Clinical Immunology I Laboratory. 2 Hours.
A laboratory with recitation involving performance of immunoassays. Emphasis on theory, methodologies, and clinical correlations. Prerequisite: CLS 523, BIOL 503 or CLS 538, or consent of instructor. LEC.

CLS 600. Introductory Biochemistry. 3 Hours.
An introduction to the chemistry and metabolism of carbohydrates, lipids, proteins, nucleic acids, and other biologically important molecules. Topics include cellular processes, reactions and interactions occurring in living organisms. Prerequisite: Admission to the Department of Clinical Laboratory Sciences or consent of instructor. LEC.

CLS 605. Introduction to Molecular Diagnostics I. 1 Hour.
An introduction to molecular biology and molecular biological methodologies and technologies commonly used in basic, applied, and diagnostic laboratories. An emphasis is placed on molecular biology principles and techniques used in the clinical laboratory for diagnosis, prognosis, and treatment of disease. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LEC.

CLS 607. Introduction to Molecular Diagnostics I Laboratory. 1 Hour.
An introduction to molecular diagnostic methodologies and technologies commonly used in clinical laboratories. Principles and performance of nucleic acid isolation, restriction enzyme digestion, electrophoresis, amplification, hybridization, and analysis. Applications in infectious and genetic disease. Prerequisite: Admission to the Clinical Laboratory Science program or Cytotechnology program or consent of the instructor. LEC.

CLS 608. Introduction to Advanced Biotechniques. 0 Hours.
A lecture course introducing the theory behind a variety of current molecular, biochemical and immunologic techniques utilized in molecular research and diagnostic laboratories. Course content is continued in CLS 610, Advanced Biotechniques Lecture. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LAB.

CLS 609. Introduction to Advanced Biotechniques Laboratory. 0 Hours.
Introductory laboratory course with practical application of selected molecular, biochemical, and immunologic techniques. Course content is continued in CLS 611, Advanced Biotechniques Laboratory. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LAB.

CLS 610. Advanced Biotechniques Lecture. 3 Hours.
A lecture course covering the theory behind a variety of current molecular, biochemical and immunologic techniques utilized in today's research and diagnostic laboratories. Material presented will include proper specimen preparation and handling; technique set-up and quality control; trouble shooting and technique modification. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LEC.

CLS 611. Advanced Biotechniques Laboratory. 2 Hours.
Student Laboratory course with practical application of selected molecular, biochemical, and immunologic techniques. Designed to provide limited experience with advanced chromatographic techniques (DEAE-cellulose, affinity columns, HPLC, and gas); multiple electrophoresis techniques (starch-gel, SDS-page, Southern blot); nucleic acid analysis and manipulation; ligand production and utilization; cell culture, including appropriate sterilization methods, aseptic handling, and steps to ensure attachment. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LAB.

CLS 621. Biotechnology Methodologies Practicum. 4 Hours.
Placement of the student in a biotechnology core facility supporting molecular biological research from multiple laboratories. Such a
core facility would provide, but not to be restricted to, the following methodologies: amino acid analysis; protein/peptide sequencing; peptide synthesis; DNA/RNA sequencing; oligonucleotide synthesis. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LAB.

**CLS 622. Problems in Molecular Diagnostics. 2 Hours.**
Provides a targeted review of current theory, techniques and application of molecular techniques in the diagnosis of infectious disease, and hereditary and acquired genetic disease. Prerequisite: Admission to the Clinical Laboratory Science or Cytotechnology program, or consent of instructor. LEC.

**CLS 623. Molecular Genetics Practicum. 4 Hours.**
Placement of the student in a molecular genetics research laboratory (utilizing either prokaryotic or eucaryotic organisms or both) working with laboratory staff on an on-going small project within the laboratory. Molecular genetics laboratories utilized could be involved in, but not restricted to, any of the following activities: gene sequencing, cloning or splicing; elucidation of the mechanisms that regulate gene expression; proto-oncogene activation. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LAB.

**CLS 633. Special Topics Practicum. 4 Hours.**
Placement of the student in any of a variety of research laboratories actively participating in molecular biological projects utilizing advanced genetic, biochemical immunologic, or other molecular techniques. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor. LAB.

**CLS 638. Clinical Competency Review. 0 Hours.**
This review will enable students to identify areas of weakness in their understanding of clinical laboratory science in preparation for clinical rotations. Students will participate in Blackboard-based and in-person laboratory sessions in order to evaluate their performance in meeting required competencies. Prerequisite: CLS 520-CLS 549 inclusive, CLS 605, CLS 607, or consent of instructor. LAB.

**CLS 639. Urinalysis. 1 Hour.**
Tutorial instruction and clinical laboratory experience in urinalysis with the application of knowledge and skills to methodology, instrumentation, and quality control. Advanced content on renal disorders with emphasis on pathological mechanisms, interpretation, and clinical correlation of test results. Prerequisite: CLS 540, or consent of instructor. LEC.

**CLS 640. Clinical Chemistry III and Immunology II. 2 Hours.**
Tutorial instruction in the chemistry of body fluids and immune function focusing on correlation of chemical and immunological analyses to disease states. Addresses organ system disease, metabolic disease, and other special topics. Prerequisite: CLS 540 and CLS 549, or consent of instructor. LEC.

**CLS 641. Clinical Chemistry and Immunology Practicum. 3 Hours.**
Tutorial instruction and clinical laboratory experience in the chemistry of body fluids, with the application of knowledge and skills to methodology, instrumentation, and quality control. Involves correlation of chemical and immunological analyses to pathophysiology. Prerequisite: CLS 540 and CLS 549, or consent of instructor. LAB.

**CLS 642. Clinical Microbiology III. 2 Hours.**
Tutorial instruction addressing pathophysiology and diagnostic protocols of viruses, rickettsia, chlamydia, mycoplasma, and other unusual organisms. Prerequisite: CLS 532, CLS 533, CLS 542 and CLS 543, or consent of instructor. LEC.

**CLS 643. Clinical Microbiology Practicum. 3 Hours.**
Tutorial instruction and clinical laboratory experience in diagnostic microbiology, with the application of knowledge and skills to methodology, instrumentation, and quality control. Prerequisite: CLS 532, CLS 533, CLS 542 and CLS 543, or consent of instructor. LAB.

**CLS 644. Immunohematology II. 1 Hour.**
Tutorial instruction addressing advanced transfusion medicine theory and concepts. Focuses on hospital transfusion services, blood utilization, management, legal and regulatory issues, and special topics. Prerequisite: CLS 544 and CLS 545, or consent of instructor. LEC.

**CLS 645. Immunohematology Practicum. 2 Hours.**
Tutorial instruction and clinical laboratory experience in transfusion medicine, with the application of knowledge and skills to methodology, instrumentation, and quality control. Prerequisite: CLS 544, CLS 545, or consent of instructor. LAB.

**CLS 646. Hematology III. 2 Hours.**
Tutorial instruction on hematologic and hemorrhagic disorders with emphasis on pathological mechanisms, interpretation, and clinical correlation of test results. Prerequisite: CLS 546 and CLS 547, or consent of instructor. LEC.

**CLS 647. Hematology Practicum. 3 Hours.**
Tutorial instruction and clinical laboratory experience in hematology, with the application of knowledge and skills to methodology, instrumentation, and quality control. Prerequisite: CLS 546 and CLS 547, or consent of instructor. LAB.

**CLS 650. Clinical Laboratory Science Review. 0 Hours.**
Review of the clinical laboratory science body of knowledge in preparation for, and culminating in the BS in CLS - Clinical Concentration comprehensive examination. Prerequisite: CLS 520-CLS 549 inclusive, CLS 605, CLS 607, CLS 661, and CLS 639-CLS 647 inclusive, or consent of instructor. LEC.

**CLS 655. Molecular Biotechnology Review. 0 Hours.**
Review of the clinical laboratory science body of knowledge in preparation for, and culminating in the BS in CLS - Molecular Biotechnology Concentration comprehensive examination. Prerequisite: CLS 520-CLS 549 inclusive, CLS 605-CLS 633 inclusive, and CLS 661 or consent of instructor. LEC.

**CLS 661. Management Principles in Health Care. 2 Hours.**
Introduction to basic principles of management and their application in the current health care environment at they pertain to the clinical laboratory. Course content includes: management theory, scope of management, quality issues, budgeting, personnel issues, evaluation and application of management concepts, introductory research methods. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor. LEC.

**CLS 670. Principles of Education in Clinical Laboratory Science. 1 Hour.**
Educational concepts including principles of learning, curriculum design, evaluation, teaching methodologies, audiovisual and library resources, accreditation, student services, and legal considerations. Prerequisite: Admission to the Clinical Laboratory Science program or consent of instructor. LEC.

**CLS 690. Special Topics. 1-5 Hours.**
A course of study offering the student the opportunity for acquisition of additional knowledge and skills in one of the clinical laboratory routine areas or a specialty area, e.g., cytogenetics, metabolic analysis, or supervision; or at another clinical site. Course requirements designed
in cooperation with student. Prerequisite: Admission to the Clinical Laboratory Science program or consent of instructor. LEC.

**CLS 705. Fundamentals of Pathophysiology. 3 Hours.**
Review of integrative human physiology with an emphasis upon homeostatic mechanisms and etiologies of disease. The interrelationships of function and dysfunction at the molecular, cellular and tissue level (pathology), organ and systemic level (impairment), and to the total human body (functional limitations) will be applied in each of the body systems. Discussions and applied materials will be tailored to the professional student population. Prerequisite: Admission to the Dietetics and Nutrition program or permission of the instructor(s). LEC.

**CLS 710. Molecular Techniques I. 2 Hours.**
A lecture course covering the theory underlying molecular techniques involving nucleic acids and mammalian cell culture. Topics include purification and analysis of nucleic acids, recombinant DNA, construction and screening of genetic libraries, genetic engineering, control of gene expression, construction of gene fusions, amplification, hybridization, and nucleic acid databases and bioinformatic analysis. Prerequisite: Admission to the MS in Molecular Biotechnology program or consent of instructor. LEC.

**CLS 711. Molecular Techniques Laboratory I. 2 Hours.**
A laboratory course emphasizing the application, practice, and troubleshooting of molecular techniques involving nucleic acids and mammalian cell culture. Topics include purification and analysis of nucleic acids, recombinant DNA, genetic engineering, control of gene expression, construction of gene fusions, amplification, and hybridization. Topics are covered through a project-based approach. Prerequisite: Admission to the MS in Molecular Biotechnology program or consent of instructor. LAB.

**CLS 720. Molecular Techniques II. 2 Hours.**
Lecture and discussion course covering the theory and practice of molecular techniques for protein analysis. General topics include: protein detection, quantification, and characterization; protein separation and identification; protein expression systems; protein extraction, fractionation, solubilization and purification; analysis of protein-protein interactions; proteomics; and mass spectroscopy. Prerequisite: Admission to the MS in Molecular Biotechnology program or consent of instructor. LEC.

**CLS 721. Molecular Techniques Laboratory II. 2 Hours.**
Laboratory course for the practice and application of molecular techniques for analyzing and manipulating proteins. Techniques will include: bioinformatics analyses; expression, purification and solubilization of epitope tagged fusion proteins, protein-protein interactions; protein quantification; protein separation by electrophoresis and column chromatography; protein detection by chemical and immunological methods; and LC-MS. Prerequisite: Admission to the MS in Molecular Biotechnology program or consent of instructor. LAB.

**CLS 730. Current Issues in Biotechnology. 1 Hour.**
A seminar course that address topics including scientific, business, legal, social, and ethical issues in biotechnology. Students explore these topics through literature discussions, student presentations, and discussions with speakers from biotechnology-related academic and industry sectors. This course is meant for graduate students in the Molecular Biotechnology program. Prerequisite: Consent of instructor. SEM.

**CLS 740. Journal Club. 1 Hour.**
This course is an introduction to the critical reading of journal articles from the current literature in molecular biotechnology. Discussions will emphasize the analysis of experimental design and technique, as well as the significance of the results and validity of the author's conclusions. Students will learn how to search for articles and background information pertaining to selected topics, an how to present a polished, professional summary of that literature. Assigned papers for discussion and student presentations will focus on new strategies and technologies in molecular biotechnology of wide fundamental importance, or on hypothesis-based research that uses molecular biotechnological approaches. Prerequisite: Completion of (or concurrent enrollment in ) CLS 710 and CLS 720. LEC.

**CLS 742. Scientific Writing. 1 Hour.**
Formats, techniques, and styles of scientific writing. Emphasis will be placed on clear, concise, and effective writing. The class will focus on the process of writing scientific manuscripts and grant proposals. Students will identify and define the sections of scientific manuscripts as well as grant proposals. During the course, each student will write an R21-type (NIH Exploratory/Developmental Research Grant) proposals as could be submitted to the most appropriate NIH Institute. This course is intended for students enrolled in their final semester of the Master of Science in Molecular Biotechnology program. Prerequisite: Consent of Instructor LEC.

**CLS 744. Topics in Molecular Biotechnology. 1-5 Hours.**
Advanced course on special topics in molecular biotechnology, offered by arrangement. May include lectures, discussions, readings, laboratory techniques, and supervised research experience. This course is intended for graduate students in the Molecular Biotechnology program. Prerequisite: Consent of instructor. LEC.

**CLS 750. Practicum I. 4 Hours.**
Advanced practical experience in a selected laboratory pursuing applied, basic, or diagnostic research projects utilizing genetic, biochemical, or other molecular biology-related approaches. Students apply and extend their knowledge and skills by performing a research and/or development project under the supervision of a site mentor. This practicum is performed at a site other than those utilized for CLS 751 (Practicum II) and CLS 752 (Practicum III). Prerequisite: Completion of CLS 710, CLS 711, CLS 720, and CLS 721, and consent of the instructor. PRA.

**CLS 751. Practicum II. 5 Hours.**
Advanced practical experience in a selected laboratory pursuing applied, basic, or diagnostic research projects utilizing genetic, biochemical, or other molecular biology-related approaches. Students apply and extend their knowledge and skills by performing a research and/or development project under the supervision of a site mentor. This practicum is performed at a site other than those utilized for CLS 750 (Practicum I) and CLS 752 (Practicum III). Prerequisite: Completion of CLS 710, CLS 711, CLS 720, and CLS 721, and consent of the instructor. PRA.

**CLS 752. Practicum III. 5 Hours.**
Advanced practical experience in a selected laboratory pursuing applied, basic, or diagnostic research projects utilizing genetic, biochemical, or other molecular biology-related approaches. Students apply and extend their knowledge and skills by performing a research and/or development project under the supervision of a site mentor. This practicum is performed at a site other than those utilized for CLS 750 (Practicum I) and CLS 751 (Practicum II). Prerequisite: Completion of CLS 710, CLS 711, CLS 720, and CLS 721, and consent of the instructor. PRA.