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, diagnostic molecular science and genetic counseling. 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.naacls.org/), 5600 N. River Road, Suite 720, Rosemont, IL 60018, 773-714-8880.

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).

Master of Science in Genetic Counseling (https://www.kumc.edu/school-of-health-professions/academics/departments/clinical-laboratory-sciences/academics/masters-in-genetic-counseling.html)

Genetic counselors are health care professionals who support individuals seeking information about inherited diseases. The workforce demand for genetic counselors continues to accelerate nationally, alongside the tremendous explosion of knowledge in the field of genetics and genetic testing. The KU master's degree program in genetic counseling is 21 months (5 semesters) in length. Students receive a well-rounded education focused on the major components of genetic counseling including genomic sciences, psychosocial counseling skills and clinical research.

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 visit Jayhawk Academic Advising (http://advising.ku.edu/).

Courses

CLS 210. Introduction to Clinical Laboratory Sciences. 1 Credits.
An introductory overview of the professions of Clinical Laboratory Sciences 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.)

CLS 520. Phlebotomy. 1 Credits.
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.

CLS 523. Fundamentals of Analytical Techniques Laboratory. 3 Credits.
This course, including lecture, recitation, and laboratory provides theory and hands-on practice of basic laboratory skills. Laboratory exercises include enhancement of skills needed for reagent preparation, pipetting of reagents and specimen, and test performance using a variety of assays (spectrophotometry, urinalysis etc.). Following the accurate collection of data in each experiment, students will analyze and interpret data applying the appropriate analytic/statistical tools, evaluate results for validity, and justify their conclusions. The theory underlying accuracy and precision in laboratory testing (quality control and quality assurance) will be included. Basic laboratory mathematics, method validation, and problem-solving strategies will be emphasized. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor.

CLS 530. Clinical Chemistry I. 3 Credits.
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: Admission to the Clinical Laboratory Sciences program or consent of the instructor.

CLS 531. Clinical Chemistry, Urinalysis, and Body Fluids Laboratory. 2 Credits.
This course, including laboratory and recitation, provides theory and hands-on practice of advanced laboratory skills. Laboratory exercises include enhancement of skills needed for reagent preparation, pipetting of reagents and specimen, and test performance using a variety of assays (spectrophotometry, electrophoresis, urinalysis, etc.). Following the accurate collection of data in each laboratory, students will analyze and interpret data applying the appropriate analytic/statistical tools, evaluate results for validity, and justify their conclusions. Theoretical and applied concepts related to the formation, collection, processing, and evaluation of urine and body fluids are included. This course also includes the study

of chemical, physical, and microscopic properties of urine and body fluids, and the correlation of findings with normal characteristics, abnormalities, and disease. Prerequisite: Admission to the Clinical Laboratory Science program and completion of CLS 539 with a grade of C or higher.

CLS 532. Clinical Microbiology I. 3 Credits.
Medically important bacteria that may be isolated from patient specimens. Topics in each area include pathophysiology of diseases caused by these organism, laboratory diagnosis and identification of organisms, and clinical correlation case studies. Other areas of study include sterilization and disinfection procedures, epidemiology, antimicrobial susceptibility testing, and quality control and quality assurance. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor.

CLS 533. Clinical Microbiology I Laboratory. 2 Credits.
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.

CLS 536. Hematology I. 3 Credits.
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.

CLS 537. Hematology I Laboratory. 2 Credits.
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.

CLS 538. Immunology. 3 Credits.
This course covers basic theory of molecular and cellular immunology of the innate and adaptive immune systems. Lectures include structure and function of antigens, 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.

CLS 539. Fundamental Techniques and Clinical Immunology Laboratory. 3 Credits.
This course, including lecture, recitation and laboratory, provides theory and hands-on practice of basic laboratory skills. It is an introduction to safety practices and fundamental laboratory training in phlebotomy, pipetting, microscopy and calibrations. It also focuses on principles and procedures of immunology and serology. Laboratory exercises consist of development of skills needed for reagent preparation and test performance using a variety of assays, accurate collection of data, and interpretation of data applying the appropriate analytic/statistical tools. The theory underlying accuracy and precision in laboratory testing (quality control and quality assurance) will be included. Basic laboratory mathematics, method validation, and problem-solving strategies are emphasized. Laboratory concepts and immunological assays, such as agglutination, precipitation and enzyme immunoassay for diagnosis of infectious diseases and immunological disorders are also included. Prerequisite: Admission to the Clinical Laboratory Science program, completion of BIOL 503 or CLS 538 (or equivalent transfer course) with a grade of C or higher, or concurrent enrollment in CLS 538, or consent of the instructor.

CLS 540. Clinical Chemistry II. 2 Credits.
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.

CLS 541. Professional Development. 2 Credits.
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.

CLS 542. Clinical Microbiology II. 2 Credits.
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.

CLS 543. Clinical Microbiology II Laboratory. 2 Credits.
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.

CLS 544. Immunohematology I. 3 Credits.
CLS 544 covers the basic theory and principles of immunohematology including: blood group systems, antibody identification, testing procedures, hemolytic disease of the newborn, autoimmune hemolytic anemias, donors and donor collection, investigation of transfusion reactions, legal and regulatory issues, and component utilization, preparation, and storage. Emphasis is on procedures utilized by blood banks to provide safe blood transfusions. Prerequisite: BIOL 503 or CLS 538, CLS 546, or consent of instructor.

CLS 545. Immunohematology I Laboratory. 2 Credits.
CLS 545 is a laboratory course emphasizing the basic techniques of blood banking including blood typing, screening and identification of antibodies, compatibility testing, and special antigen testing. In addition, students will be introduced to common diagnostic procedures used in the evaluation of special problems such as hemolytic disease of the newborn and transfusion reactions. Prerequisite: BIOL 503 or CLS 538, CLS 546, or consent of instructor.

CLS 546. Hematology II. 3 Credits.
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.

CLS 547. Hematology II Laboratory. 2 Credits.
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.

CLS 549. Clinical Immunology I Laboratory. 2 Credits.
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.

CLS 600. Introductory Biochemistry. 3 Credits.
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.

CLS 605. Introduction to Molecular Diagnostics I. 1 Credits.
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.

CLS 607. Introduction to Molecular Diagnostics I Laboratory. 1 Credits.
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.

CLS 608. Introduction to Advanced Biotechniques. 0 Credits.
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.

CLS 609. Introduction to Advanced Biotechniques Laboratory. 0 Credits.
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.

CLS 610. Advanced Biotechniques Lecture. 3 Credits.
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.

CLS 611. Advanced Biotechniques Laboratory. 2 Credits.
Laboratory course with practical application of selected molecular, biochemical, and immunological techniques. Designed to provide limited experience with protein purification and analysis techniques, electrophoresis techniques, nucleic acid analysis and manipulation. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor.

CLS 621. Biotechnology Methodologies Practicum. 4 Credits.
Placement of the student in clinical laboratories performing molecular diagnostic techniques for the analysis of infectious diseases, hereditary conditions, or acquired genetic conditions. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of instructor.

CLS 622. Problems in Molecular Diagnostics. 2 Credits.
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.

CLS 623. Molecular Genetics Practicum. 4 Credits.
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.

CLS 633. Special Topics Practicum. 4 Credits.
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.

CLS 638. Clinical Competency Review. 0 Credits.
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.

CLS 639. Urinalysis. 1 Credits.
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.

CLS 640. Clinical Chemistry III and Immunology II. 2 Credits.
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.

CLS 641. Clinical Chemistry and Immunology Practicum. 3 Credits.

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.

CLS 642. Clinical Microbiology III. 2 Credits.
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.

CLS 643. Clinical Microbiology Practicum. 3 Credits.
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.

CLS 644. Immunohematology II. 1 Credits.
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.

CLS 645. Immunohematology Practicum. 2 Credits.
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.

CLS 646. Hematology III. 2 Credits.
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.

CLS 647. Hematology Practicum. 3 Credits.
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.

CLS 650. Clinical Laboratory Science Review. 0 Credits.
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.

CLS 655. Molecular Biotechnology Review. 0 Credits.
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.

CLS 661. Management Principles in Health Care. 2 Credits.
Introduction to basic principles of management, education, and research and their application in the current health care environment. Course content includes: management theory, scope of management, quality issues, budgeting, personnel issues, evaluation and application of management concepts; introductory research methods and evaluation of journal articles. Prerequisite: Admission to the Clinical Laboratory Sciences program or consent of the instructor.

CLS 690. Special Topics. 1-5 Credits.
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.

CLS 710. Molecular Techniques I. 2 Credits.
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.

CLS 711. Molecular Techniques Laboratory I. 2 Credits.
A laboratory course emphasizing the application, practice, and trouble-shooting 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.

CLS 720. Molecular Techniques II. 2 Credits.
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.

CLS 721. Molecular Techniques Laboratory II. 2 Credits.
Laboratory course for the practice and application of molecular techniques for analyzing and manipulating proteins. Techniques will include: bioinformatics analyses; epression, 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.

CLS 730. Current Issues in Biotechnology. 1 Credits.
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.

CLS 740. Journal Club. 1 Credits.
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.

CLS 742. Scientific Writing. 1 Credits.
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

CLS 744. Topics in Molecular Biotechnology. 1-5 Credits.
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.

CLS 750. Practicum I. 4 Credits.
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.

CLS 751. Practicum II. 5 Credits.
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.

CLS 752. Practicum III. 5 Credits.
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.

Courses

DCLS 800. DCLS Advanced Topics. 1 Credits.
Seminar course that addresses topics and issues relevant to DCLS clinical practice, including ethical and social issues in healthcare practice, health informatics, and communication techniques needed for interaction with healthcare colleagues and patients. Repeatable. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 802. Principles of Healthcare Education. 3 Credits.
This course will address various aspects of teaching in healthcare settings. This includes educating patients and their families, educating other healthcare professionals, and the more formal area of undergraduate and graduate education. Education theory, pedagogical methods, educational resources, learning objectives, and evaluation techniques applicable to each type of educational situation will be addressed. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 805. Advanced Molecular Diagnostics. 2 Credits.
This course focuses on the enhancement of scientific and technical knowledge in nucleic acid-based testing for the diagnosis of acquired and hereditary genetic disorders, and infectious diseases. Topics include an in-depth review of the theory of molecular techniques and the application of these techniques in inherited disorders, oncology, infectious disease, pharmacogenetics, histocompatibility, identity determination, and genomics. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 815. Research Methods in Clinical Laboratory Sciences. 2 Credits.
A discussion of research methods used in clinical laboratory sciences, with an emphasis on selecting and applying appropriate research designs. Includes an overview of the research methods and various approaches in current use in clinical laboratory science; focused on research question formulation; internal and external validity of research; variable measurement and reliability, and generalizability of findings. Specific approaches covered include non-experimental, experimental and quasi-experimental designs, epidemiologic methods (e.g., cohort and case-control studies), survey research, and qualitative research. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 820. Evidence Based Practice. 3 Credits.
Evidence-Based Practice (EBP) encompasses Evidence-Based Medicine and Evidence-Based Laboratory Medicine. EBP is a problem-based approach to decision making using research evidence combined with clinical expertise, the patient's values, circumstances, and the clinical context. This course addresses the historical development of EBP, why using EBP in clinical decision making improves patient care, when and how to implement and use EBP in clinical decision making, and how to discuss the EBP finding with patients, family members, and other healthcare practitioners. Evaluating research studies for their applicability to EBP and designing research studies based on clinical evidence focused on laboratory testing will make up most of the course content, activities, and assignments. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 828. Advanced Immunology and Transplant. 3 Credits.
This course focuses on enhancement of scientific and technical knowledge in clinical immunology and transplantation in order to consult with other healthcare practitioners on clinical applications and diagnostic and therapeutic testing of immune-mediated diseases. Topics include autoimmunity, hypersensitivity, immunotherapy and immunotoxicology, transplantation and HLA testing/compatibility, cancer immunology and immunodeficiency. This course also includes test methodologies in cellular, humoral, and molecular immunology, selection and interpretation of test results, and recommendations for follow-up testing for patient monitoring. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 830. Advanced Clinical Chemistry. 3 Credits.
This course focuses on in depth physiology and pathophysiology together with the principles of current and emerging chemistry tests. Emphasis on the correlation between chemistry tests and disease states, interpretation and limitations of chemistry test results. Current clinical chemistry literature, clinical scenarios, case studies, and advanced laboratory practice issues will be used to enhance knowledge and skills. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 836. Advanced Hematology. 3 Credits.
This course focuses on enhancement of scientific and technical knowledge in hematology and hemostasis to consult with other healthcare practitioners on the selection of screening and diagnostic tests for hematological disorders, interpretation of results, and recommendations for follow-up testing. Topics to be investigated include physiology and regulation of the hematopoietic system and hemostasis, and the genetic, molecular and cellular mechanisms underlying the pathophysiology of selected hematological disorders such as anemias, leukemias, lymphomas, and disorders of hemostasis with additional focus on utilization of appropriate hematology, hemostasis, and molecular diagnostic tests, and reducing turn-around time. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 838. Advanced Immunology and Transplant. 3 Credits.
This course focuses on enhancement of scientific and technical knowledge in clinical immunology and transplantation in order to consult with other healthcare practitioners on clinical applications and diagnostic and therapeutic testing of immune-mediated diseases. Topics include autoimmunity, hypersensitivity, immunotherapy and immunotoxicology, transplantation and HLA testing/compatibility, cancer immunology and immunodeficiency. This course also includes test methodologies in cellular, humoral, and molecular immunology, selection and interpretation of test results, and recommendations for follow-up testing for patient monitoring. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 842. Advanced Clinical Microbiology. 3 Credits.
Course Description: This course focuses on enhancement of scientific and technical knowledge in clinical microbiology necessary for consultation with other healthcare practitioners for (i) the selection of screening and diagnostic tests for suspected infectious diseases, (ii) interpretation of

results, and (iii) recommendations for follow-up testing. Topics to be investigated include utilizing molecular diagnostic tests, antimicrobial susceptibility testing and resistance mechanisms, bioterrorism, biofilms, opportunistic and emerging infections, utilization of appropriate microbiology tests, evidence based practice in clinical microbiology, and reducing turn-around time. Current scientific literature, clinical scenarios, case studies, and advanced laboratory practice issues will be used to enhance knowledge and skills. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 844. Advanced Immunohematology. 3 Credits.
This course will explore advanced blood banking theory and transfusion medicine concepts pertaining to basic-to-advanced serological testing techniques, blood product utilization, molecular immunohematology testing methods, quality assurance, and other relevant topics. Learners will be re-introduced to specialized blood banking procedures including (but not limited to) the following: ABO/Rh, antibody screens, antibody identification, fetal screen, elutions, phenotyping, and crossmatching. Using case studies and discussion, learners will correlate laboratory data to clinical disease processes encountered in transfusion medicine. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 851. Clinical Correlations I. 3 Credits.
Course Description: This course will correlate clinical presentation and laboratory testing as it relates to physiological changes associated with select diseases of major organ systems (e.g., endocrine, muscle, cardiovascular, respiratory, renal, gastrointestinal, immune, nervous, and reproductive). Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program or instructor permission.

DCLS 852. Clinical Correlations II. 3 Credits.
This course will complement DCLS 851 Clinical Correlations I and will correlate clinical laboratory testing as it relates to physiological changes associated with patient symptomology (e.g., chest pain, shortness of breath, unresponsiveness, fever of unknown origin, jaundice) and treatment in a consultation model. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program or instructor permission.

DCLS 880. Principles of Interprofessional Education and Practice Theory. 1 Credits.
An introductory course to core competencies in interprofessional education and practice for healthcare teams including roles and responsibilities, values and ethics, teamwork, communication, and collaborative practice as it relates to the improvement of patient safety outcomes and the provision of quality patient care. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 881. DCLS Interprofessional Practice. 1 Credits.
This course is designed for DCLS program students to apply core competencies in interprofessional practice for healthcare teams including roles and responsibilities, values and ethics, teamwork, communication, and collaborative practice via participation in interprofessional activities. Prerequisite: Successful completion of DCLS 880 and admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 890. Advanced Laboratory Operations. 3 Credits.
This course will explore laboratory quality, utilization, accreditation, regulation, and management topics. Core course content explores the selection, implementation, strengths, and weaknesses of appropriate quality assurance programs to maintain desired quality goals. All aspects of laboratory services will be explored to enhance consultative skills that will be applied in the clinical residency. The use of practice guidelines, critical or clinical pathways, algorithms and reflex testing, direct access testing, evidenced-based practice, and outcomes measurements, as well as initiatives to change the practice of laboratory services in all phases (pre-analytical, analytical, and post analytical) are covered. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program, or consent of instructor.

DCLS 899. Independent Study. 1-3 Credits.
Faculty-guided, student-directed individualized study for students enrolled in the DCLS program who need additional enrollment associated with their plan of study. The specific course requirements are to be described in the Independent Study proposal form to be completed by the student and approved by the faculty mentor and DCLS Program Director prior to enrollment. Can be repeated for credit. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program.

DCLS 901. DCLS Research I. 2 Credits.
Research I is part of a three-course series (DCLS 901, DCLS 902, DCLS 903) taken consecutively. The goal of DCLS 901 is to initiate the development of a research project by preparing a formal written research proposal that includes selecting a topic, reviewing current literature, preparing and submitting an IRB approval, and other activities required to begin data collection. Prerequisite: Admission into the Doctorate in Clinical Laboratory Science program.

DCLS 902. DCLS Research II. 3 Credits.
Research II is part of a three-course series (DCLS 901, DCLS 902, DCLS 903) taken consecutively. The goal of DCLS 902 is to continue the work begun in DCLS 901 by initiating data collection, analyzing and interpreting the data collected, beginning the writing of a manuscript draft, and other activities required to move the research project forward. Prerequisite: Satisfactory completion of DCLS 901.

DCLS 903. DCLS Research III. 3 Credits.
Research III is part of a three-course series (DCLS 901, DCLS 902, DCLS 903) taken consecutively. The goal of DCLS 903 is to complete the project begun in DCLS 901 and DCLS 902 by finalizing the analysis and interpretation of the data collected and develop a defendable conclusion regarding the research hypothesis. Completion of a final draft of the manuscript describing the research project and outcomes is the culmination of this course. Prerequisite: Satisfactory completion of DCLS 902.

DCLS 911. Clinical Residency I. 4 Credits.
The first of a three-course series (DCLS 911, DCLS 912, DCLS 913) providing a structured and supervised experience correlating coursework with practice. Designed to develop the DCLS student to meet national professional responsibilities. Students work with management, laboratory staff, physicians, nurses, and other members of the healthcare team to provide guidance in laboratory utilization and interpretation to optimize patient outcomes. Requires 14-16 weeks of full-time placement at a program affiliate. Prerequisite: Permission of instructor.

DCLS 912. Clinical Residency II. 5 Credits.
The second of a three-course series (DCLS 911, DCLS 912, DCLS 913) providing a structured and supervised experience correlating coursework with practice. Designed to develop the DCLS student to meet national professional responsibilities. Students work with management, laboratory staff, physicians, nurses, and other members of the healthcare team to provide guidance in laboratory utilization and interpretation to optimize patient outcomes. Requires 14-16 weeks of full-time placement at a program affiliate. Prerequisite: Permission of instructor.

DCLS 913. Clinical Residency III. 5 Credits.
The third of a three-course series (DCLS 911, DCLS 912, DCLS 913) providing a structured and supervised experience correlating coursework with practice. Designed to develop the DCLS student to meet national professional responsibilities. Students work with management, laboratory

staff, physicians, nurses, and other members of the healthcare team to provide guidance in laboratory utilization and interpretation to optimize patient outcomes. Requires 14-16 weeks of full-time placement at a program affiliate. Prerequisite: Permission of instructor.

DCLS 999. DCLS Capstone. 1 Credits.
The capstone is completed during the final semester of the program and consists of a written manuscript and an oral examination. The manuscript, suitable for publication, is based on the research developed and completed during the research course series DCLS 901, 902, and 903. The final oral defense will be scheduled once the final draft of the manuscript is accepted by the student's Graduate Committee. The oral examination is a defense of the manuscript and can include questions regarding general knowledge of clinical laboratory science concepts and applications from across the entire DCLS curriculum. Prerequisite: Satisfactory completion of DCLS 902.

Courses

GENC 801. Introduction to Clinical Research. 1 Credits.
This course is designed to introduce students to the clinical research process and build the foundations necessary for their thesis or capstone projects. The course will explore the essential elements of research including topic selection, formulation of a research question, aim, and hypothesis, literature review, identification of a mentor, research design and methodology, research ethics, the protection of human subjects, and the role of the Institutional Review Board (IRB). Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 802. Fundamentals of Genetic Counseling. 2 Credits.
This course provides a framework for the development of clinical skills in genetic counseling. Major components include completing the intake, recording the family history, recognizing dysmorphic features, developing a differential diagnosis, identifying counseling aids and resources, medical documentation, and components of the genetics physical examination. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 803. Human Genetics. 3 Credits.
Topics covered this semester will include gene structure and function, chromosomal abnormalities, single gene inheritance, molecular, cellular and biochemical basis of genetic disease, complex and multifactorial inheritance, genetic diversity, risk calculation in genetic counseling, and population genetics. Techniques of genetic analysis and appropriate nomenclature will be introduced. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 804. Psychosocial Genetic Counseling. 4 Credits.
Students will develop skills to be able to organize a genetic evaluation/counseling session, conduct a psychosocial assessment, apply basic counseling skills, obtain a history including targeted family history, provide patient education, and make a follow-up plan for a genetics diagnostic evaluation. Additionally, students will examine their own beliefs and backgrounds, and understand how these may impact their ability to provide genetic counseling. The course is organized to provide theory and application in the form of role play and practice with standardized patients at the Clinical Skills Lab. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 811. Research in Genetic Counseling. 1 Credits.
This course will provide a framework for the development of the student's research topic. Students will identify the members of their research committee, refine specific aims/hypotheses, and learn methods of data collection, basic biostatistics, and manuscript writing used in genetic counseling research. Students will also hear from genetic counselors who work in research. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 812. Cytogenetic and Molecular Basis of Disease. 2 Credits.

Students will become familiar with cytogenetic and molecular laboratory testing and methodology, components of a test report, variant analysis, genome-wide association studies, polygenic risk scores, emerging technologies, and use of personalized medicine. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 821. Clinical Fieldwork I. 1 Credits.
This course provides the student with practical experience performing supervised genetic counseling for patients referred for a variety of health concerns. Each student will participate in three clinical rotations each lasting five weeks. Students will begin practicing skills of case preparation, contracting, medical intake, pedigree drawing, describing the natural history of disorders, reviewing testing options, identifying psychosocial concerns, and resource identification. Students are expected to participate in 2-4 cases per week during this course, increasing with each rotation. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 822. Prenatal Genetics and Teratology. 2 Credits.
This course combines case-based learning, presentations from topic experts and class discussion to prepare students for clinical practice in reproductive genetic counseling. Topics include routine pregnancy care, prenatal screening and diagnostic testing, ultrasound anomalies, evaluation for infertility, recurrent pregnancy loss and stillbirth; assisted reproductive technologies; teratology; fetal treatment and intervention; perinatal loss and bereavement. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 832. Medical Genetics I. 2 Credits.
The Medical Genetics course series offers an overview of concepts in medical genetics including natural history, cardinal features, management, and treatment of pediatric and adult genetic syndromes. Therapeutic approaches and treatment modalities including gene therapy and clinical trials will be reviewed. Guest lecturers with relevant clinical expertise will be invited to speak. A special focus on disability and advocacy will include presentations from families and patients affected by genetic conditions. This course utilizes case-based learning supplemented by lectures, quizzes, and jeopardy-style reviews. Sections I, II and III can be taken in any order. Topics in Medical Genetics I will include: Cardiovascular Genetics, Neurogenetics, Kidney, GI, Lung and Liver disorders, Neurocutaneous disorders, RASopathies, and syndromes associated with brain malformations, seizures and microcephaly. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 833. Clinical Fieldwork II. 3 Credits.
This course provides the student with practical experience performing supervised genetic counseling for patients referred for a variety of health concerns. Each student will participate in one clinical rotation lasting seven weeks. Students will continue to improve upon skills learned in Clinical Fieldwork I including case preparation, resource identification, contracting, medical intake, pedigree drawing, reviewing testing options, presenting research opportunities, and identifying psychosocial concerns with the goal of becoming competent at performing these skills independently. Students will practice skills of risk assessment, risk counseling, describing the natural history of disorders, results disclosure, follow-up, documentation, and advanced psychosocial counseling. Students will attempt to perform basic psychosocial counseling. Students are expected to participate in 4-6 cases per week during this course.

Prerequisite: Clinical Fieldwork I. Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 842. Biochemical Genetic Counseling. 2 Credits.
Examine the biochemical basis of human disease with emphasis on the role of the genetic counselor, including recognition of various biochemical diseases, including phenotypes, inheritance patterns, diagnostic methods, biochemical signatures, and treatments. Students will also explore the concepts of newborn screening and the various roles of the genetic counselor in the metabolic clinic. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 852. Cancer Genetic Counseling. 2 Credits.
This course will cover topics including cancer nomenclature, epidemiology, etiology and hereditary cancer predisposition syndromes. It will address risk assessment, molecular testing, screening and risk management recommendations. Discussions will include psychosocial implications of diagnosis. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 862. Laboratory/Industry. 2 Credits.
In this course students will become familiar with the role of genetic counselors and other professionals in non-patient facing roles with a significant focus on laboratory settings (e.g., commercial, academic, research, and/or public health screening laboratories), including their involvement in the performance and interpretation of genetic/genomic tests, test development and implementation, customer liaison and support, and sales and marketing. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 902. Advanced Psychosocial Genetic Counseling. 2 Credits.

Builds on GENC 804; This course will focus on advanced psychosocial and genetic counseling skills and will cover topics including delivering difficult news, grief and loss, recognizing and managing a crisis and genetic counseling related to a variety of patient affects. The course is organized to provide theory and application in the form of role play and practice with standardized patients at the Clinical Skills Center. Prerequisite: GENC 804; Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 903. Genetic Counseling Thesis/Capstone. 3 Credits.
This faculty guided, student-directed course provides credit for the implementation and completion of genetic counseling student thesis or capstone projects. Prerequisite: GENC 801; GENC 811; Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 912. Professional Development I. 2 Credits.
The course will provide information on a range of topics related to professional development as a Genetic Counselor including CV development, interviewing skills, licensure, insurance and reimbursement, and developing familiarity with the healthcare system as it relates to genetic counseling. Students will also present a journal club article. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 913. Clinical Fieldwork III. 3 Credits.
This course provides the student with practical experience performing supervised genetic counseling for patients referred for a variety of health concerns. Each student will participate in three clinical rotations each lasting five weeks. Students will continue to improve upon skills learned in Clinical Fieldwork II including documentation and advanced psychosocial counseling. Students will become competent or proficient in the core roles of genetic counseling sessions. Students are expected to participate in 4-6 cases per week during this course. Prerequisite: Clinical Fieldwork I and II. Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 922. Medical Genetics II. 2 Credits.
The Medical Genetics course series offers an overview of concepts in medical genetics including natural history, cardinal features, management, and treatment of pediatric and adult genetic syndromes. Therapeutic approaches and treatment modalities including gene therapy and clinical trials will be reviewed. Guest lecturers with relevant clinical expertise will be invited to speak. A special focus on disability and advocacy will include presentations from families and patients affected by genetic conditions. This course utilizes case-based learning supplemented by lectures, quizzes, and jeopardy-style reviews. Sections I, II and III can be taken in any order. Topics in Medical Genetics II will include: Neuromuscular disorders, skeletal dysplasias, bone disorders, ciliopathies, psychiatric disorders, pharmacogenetics, adult-onset disorders and syndromes associated with hearing loss, limb anomalies, craniosynostosis, arteriovenous malformations, and overgrowth. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 932. Social, Ethical and Legal Issues in Genetics. 2 Credits.

In this course students will discuss topics including ethical principles, ethics cases, cultural awareness, newborn screening, GINA, and various DEI topics including assessing our own biases, self-reflection, strategies for reducing microaggressions, and issues related to GC admissions. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 933. Clinical Fieldwork IV. 3 Credits.
This course provides the student with practical experience performing supervised genetic counseling for patients referred for a variety of health concerns. Each student will participate in three clinical rotations each lasting five weeks. Students will continue to build upon skills learned in Clinical Fieldwork I, II, and III. Students will become proficient in all roles of genetic counseling sessions. Students are expected to participate in 6 cases per week during this course. Prerequisite: Clinical Fieldwork I, II and III. Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 942. Medical Genetics III. 2 Credits.
The Medical Genetics course series offers an overview of concepts in medical genetics including natural history, cardinal features, management, and treatment of pediatric and adult genetic syndromes. Therapeutic approaches and treatment modalities including gene therapy and clinical trials will be reviewed. Guest lecturers with relevant clinical expertise will be invited to speak. A special focus on disability and advocacy will include presentations from families and patients affected by genetic conditions. This course utilizes case-based learning supplemented by lectures, quizzes, and jeopardy-style reviews. Sections I, II and III can be taken in any order. Topics in Medical Genetics III will include: common microdeletion/microduplication syndromes, FLNA-related disorders, blood disorders, mosaic syndromes, ophthalmologic disorders, diabetes, and syndromes associated with craniofacial anomalies, sexual development, chromosome breakage, telomere length, bone marrow failure, skin findings, immune dysfunction, and intellectual disability. Prerequisite: Admission into the Master of Science in Genetic Counseling program, or consent of instructor.

GENC 952. Professional Development II. 2 Credits.
This course will provide information on a range of topics related to professional growth as a Genetic Counselor including supervision, program development, self-care, professional organizations, opportunities for professional growth and identifying a professional mentor. Students

will also present journal club articles. Prerequisite: Professional Development I; Admission into the Master of Science in Genetic Counseling program, or consent of instructor.