Doctor of Clinical Laboratory Sciences

The Doctorate in Clinical Laboratory Science (DCLS) is the terminal practice degree for the Clinical Laboratory Science profession. This degree provides an opportunity for advanced practice in multiple venues including clinical institutions, reference laboratories, physician practices, industry, public health agencies, government facilities, and academic institutions. Clinical Laboratory Science professionals holding the DCLS will provide a critical interface between practice, research, and health care policy. They will assure the effective and appropriate utilization of laboratory tests and information by eliminating unnecessary tests and ordering tests that should have been ordered but were not. This will result in decreased costs, earlier diagnosis, and improved patient outcomes.

The three-year, full-time program consists of 76 credit hours divided between advanced theory courses (core curriculum), research, and a one-year clinical residency. Course delivery may include face-to-face, online, and hybrid formats. The core curriculum may be completed on a part-time basis. However, the residency component requires full-time attendance at a clinical affiliate.

The core curriculum is designed to advance the foundational knowledge of the bachelor's-level medical laboratory scientist in the areas of hematology, clinical chemistry, clinical microbiology, immunohematology, clinical immunology, and molecular diagnostics. Information gained from this course work is integrated with knowledge from other disciplines in health care such as health policy and management, pharmacology, health care education, public health and epidemiology, and advanced pathophysiology.

Research is a component of this program and students will be expected to complete research projects over the course of the program culminating in a capstone project suitable for publication. Research projects will advance practice in clinical laboratory medicine, such as the development and implementation of diagnostic and interpretive algorithms, clinical practice guidelines, and collaborative interprofessional patient care.

The one-year clinical residency will provide immersion in the workings of the health care system by integrating the resident into patient care alongside physicians, nurses, pharmacists, and other health care professionals in clinical practice environments at program affiliates. During the residency, the students will work with management, laboratory staff, physicians, nurses, and other members of the healthcare team to provide guidance in laboratory utilization and interpretation thereby optimizing patient outcomes. The residency focuses on laboratory test selection and result interpretation. In addition to the direct learning by the resident, he or she can educate the patient and the other members of the health care team on the proper utilization of lab tests, correct specimen requirements, and interfering factors affecting results.

Graduates of this program will be prepared to act as consultants to health care providers, serve as laboratory directors, educate patients and health care providers, perform and disseminate research on evidence-based practice and test utilization, and enter academic positions.

The DCLS curriculum addresses the competencies established for the profession by the American Society for Clinical Laboratory Science Doctorate in Clinical Laboratory Science Oversight Committee and NAACLS accreditation guidelines for the DCLS.

Admission to the doctorate in clinical laboratory science program is a competitive application process. Applications and supporting materials are reviewed, and qualified applicants are invited for a personal interview. Applicants for this program are accepted online. Detailed instructions on how to apply are posted on the doctorate in clinical laboratory science program (http://www.kumc.edu/school-of-health-professions/clinical-laboratory-sciences/doctorate-in-cls/how-to-apply.html) website. Students are admitted for the fall semester only. Applications for the fall semester must be received by February 1 for first consideration.

In order to be considered for admission into this program, the following are required:

- **Completed prerequisite course work**
  - Bachelor's degree in a life science (e.g., biochemistry, biology, cell biology, clinical laboratory science, microbiology, molecular biosciences etc.) must be completed prior to enrollment in the program.
  - A NAACLS-accredited MLS/MT program must be completed (or equivalent).

- **Grade point average**
  - Cumulative undergraduate grade point average of 3.00 on a 4.00 scale is required.
  - For applicants who transferred credits into their Bachelor's degree, the Office of Graduate Studies will take those credits into consideration for the cumulative Bachelor's GPA.
  - Applicants with a GPA below 3.00 may be considered for admission on a case-by-case basis.

- **Entrance examination**
  - Successful completion of the Graduate Record Examination OR the Medical College Admission Test taken within the last five (5) years is required. A subject test is not required for the GRE.

- **Required credentials**
  - Professional certification as a generalist from the American Society of Clinical Pathology Board of Certification is required: MLS(ASCP)CM, MLS(ASCP)i, or MT(ASCP) with proof of continuing education equivalent to the BOC CMP.

- **Professional work experience**
  - A minimum two-years, post-certification, full-time experience in a clinical laboratory as a medical laboratory scientist is required at the time of application. Preference will be given to those with experience as a generalist or who have worked in multiple areas of the clinical laboratory. Applicants with less than two-years of full-time experience may be considered for admission on a case-by-case basis.
  - The department will evaluate work experience and determine if the work experience criteria are met for each applicant.

- **Health and physical requirements**
  - Good physical and mental health are essential. Physical or other disabilities are evaluated on a case-by-case basis by the program and by the Office of Equal Opportunity and Academic Compliance. Please review the program's technical standards (http://www.kumc.edu/school-of-health-professions/clinical-laboratory-
DCLS Core Course Descriptions

DCLS 800 Advanced Topics (1)
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.

DCLS 802 Principles of Healthcare Education (3)
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.

DCLS 805 Advanced Molecular Diagnostics (2)
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. Topics include: selection of appropriate screening and diagnostic tests and techniques; results interpretation in the context of other laboratory and clinical data; monitoring disease progression, therapeutic efficacy, and follow-up recommendations; communicating results and providing consultation to healthcare practitioners and other stakeholders in a professional manner including ethical considerations. Current scientific literature, clinical scenarios, case studies, and advanced laboratory practice issues will be used to enhance knowledge and skills.

DCLS 815 Research Methods in Clinical Laboratory Sciences (2)
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 scientific method and various research models in current use in clinical laboratory science; the role of theory in problem formulation; internal and external validity; variable measurement and reliability, and generalizability of findings. Specific approaches covered include experimental and quasi-experimental treatment designs, epidemiologic methods (cohort and case-control studies), survey research, evaluation and outcomes research, methodological studies and qualitative research.

DCLS 820 Evidence Based Practice (3)
This course provides foundation skills in research-oriented bibliographic inquiry, with an emphasis on evidence-based review and synthesis of applicable literature in laboratory medicine. Principles of effective scientific communication are also addressed, including how to plan, organize and write structured systematic review articles.

DCLS 830 Advanced Clinical Chemistry (3)
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.

DCLS 836 Advanced Hematology (3)
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 hemorrhage with additional focus on utilization of appropriate hematology, hemostasis, and molecular diagnostic tests, and reducing turn-around time.

DCLS 838 Advanced Immunology/Transplant (3)
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, diagnostic and therapeutic testing of immune-mediated diseases in autoimmunity, pregnancy, anaphylaxis and allergy, immunotherapy and immunotoxicology, transplantation and HLA testing/compatibility, cancer immunology and immunodeficiency. Topics include test methodologies in cellular, humoral, and molecular immunology, selection and interpretation of test results, and recommendations for follow-up testing for patient monitoring. Current scientific literature, clinical scenarios, case studies, and advanced laboratory practice issues will be used enhance knowledge and skills.

DCLS 842 Advanced Clinical Microbiology (3)
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.

DCLS 844 Advanced Immunohematology (3)
This course focuses on enhancement of scientific and technical knowledge in clinical immunohematology in order to consult with other healthcare practitioners on the identification, resolution, and selection of blood products for rare or multiple blood group system antibodies, interpretation of test results, and recommendations for follow-up testing and transfusion recommendations. Additional topics to be investigated include: therapeutic indications for transfusion, transfusion requirements in special situations, the pathophysiology and investigation of adverse transfusion reactions are also examined, blood utilization management, research in blood component collection and storage, and regulatory agency requirements. Current scientific literature, clinical scenarios, case studies, and advanced laboratory practice issues will be used to enhance knowledge and skills.

DCLS 851 Clinical Correlations I (3)
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). Diseases will be reviewed with focus on changes in laboratory parameters. Class will include lectures, student presentations, evaluations of research papers, and discussions.

DCLS 852 Clinical Correlations II (3)
This course will build on CLS851 Clinical Correlations I and will correlate clinical laboratory testing as it relates to physiological changes associated with other diseases of the major organ systems (endocrine, muscle, cardiovascular, respiratory, renal, gastrointestinal, immune, nervous, and reproductive). Diseases will be reviewed with focus on changes in laboratory parameters. Class will include lectures, student presentations, evaluations of research papers, and discussions.

DCLS 880 DCLS Interprofessional Practice (1)
This course will build DCLS communication and practice skills within the interprofessional healthcare team. Students will learn with, from, and about other health professions, as well as role of interprofessional collaboration in improving the quality and safety of patient care. Methods used to develop knowledge and skills may include simulation and group-based activities. Repeatable.

DCLS 890 Advanced Laboratory Operations (3)
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.

The Doctorate in Clinical Laboratory Science (DCLS) program at the University of Kansas is designed to prepare certified medical laboratory scientists for advanced practice in multiple venues including clinical institutions, reference laboratories, physician practices, industry, public health agencies, government facilities, and academic institutions. Course work is divided between advanced theory courses ("Core Curriculum"), research, and clinical residency. The DCLS curriculum addresses the competencies established for the profession by the American Society for Clinical Laboratory Science Doctorate in Clinical Laboratory Science Oversight Commitee and NAACLS accreditation guidelines for the DCLS.

Degree Requirements:

- On a full-time basis, degree requirements are normally completed within 3 years of admission to the program, although a maximum of 8 years is allowed. The core curriculum can be complete on a part-time basis, but the DCLS Research and Clinical Residency components require one year of full-time enrollment.
- Cumulative grade-point average (GPA) of at least 3.0 for all KU graduate coursework.
- Successful completion of a minimum of 76 credit hours.
- Successful completion of the University's Research Skills and Responsible Scholarship requirement before proceeding to the DCLS comprehensive exam.
  - Successful completion of DCLS 815 (Research Methods in Clinical Laboratory Sciences) and DCLS 820 (Evidence Based Practice) meets the Research Skills requirement.
  - Successful completion of PRVM 853 (Responsible Conduct of Research) meets the Responsible Scholarship requirement.
  - Successful completion of the DCLS comprehensive examination. Upon completion of the core curriculum, a comprehensive examination is required of all degree candidates. Students will demonstrate their (i) command of the clinical laboratory science body of knowledge, (ii) ability to statistically analyze data, and (iii) expertise in the broad scope of clinical practice. Students must be in good academic standing (i.e. hold a minimum 3.0 cumulative GPA) to be
eligible for the comprehensive examination. The examination must be completed prior to enrollment in residency courses with a minimum score of 80% to be considered successful.

- Successful completion of the DCLS Research Project requirement. A prospectively planned and approved translational research project which is advisor-guided, student-directed, and designed to support and enhance students’ ability to apply their graduate knowledge and achieve tangible outcomes. The DCLS Research Project is a three-course series (DCLS 901, DCLS 902, DCLS 903) that includes all aspects of a translational research project, including the planning, data collection, analysis/interpretation of results, preparation, and presentation of the research project, both oral and written. Research projects will advance practice in clinical laboratory medicine, such as the development and implementation of diagnostic and interpretive algorithms, clinical practice guidelines, and collaborative interprofessional patient care.

- Successful completion of the DCLS Clinical Residency requirement. A three-course series (DCLS 911, DCLS 912, DCLS 913), this year-long clinical residency is designed to develop the DCLS professional to meet national professional responsibilities. Residency places the student in clinical practice environments at program affiliates. During the residency, the students will work with management, laboratory staff, physicians, nurses, and other members of the healthcare team to provide guidance in laboratory utilization and interpretation thereby optimizing patient outcomes. Residency is provided in structured clinical rotations occurring at clinical affiliates. Skills and knowledge will be evaluated through competency-based assessments and portfolio development. The portfolio will contain documentation of experiences and work products developed during the residency rotations. This may include de-identified summaries of consultations, papers and abstracts published or submitted, PowerPoint presentations, method evaluation data and/or written procedures from utilization projects.

- Successful completion of the DCLS Capstone requirement. The capstone is completed during the final semester of the program and consists of a written and an oral examination. The written component consists of a manuscript suitable for publication based on the research requirement described above. The oral examination is a defense of the manuscript and can include questions regarding general knowledge of clinical laboratory science concepts and applications.

- Enrollment in a minimum of one (1) credit hour the semester the student will graduate.

- Successful completion of the following courses:

<table>
<thead>
<tr>
<th>Course Name &amp; Number</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Core Curriculum</td>
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<tr>
<td>DCLS 800 Advanced Topics</td>
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<td>DCLS 802 Principles of Healthcare Education, or</td>
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<tr>
<td>MICR 805 Teaching in Higher Education</td>
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<td>DCLS 805 Advanced Molecular Diagnostics</td>
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<td>DCLS 815 Research Methods in Clinical Laboratory Sciences</td>
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<td>DCLS 820 Evidence Based Practice</td>
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<td>DCLS 830 Advanced Clinical Chemistry</td>
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<td>DCLS 836 Advanced Hematology</td>
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<td>DCLS 838 Advanced Immunology/Transplant</td>
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<td>DCLS 842 Advanced Clinical Microbiology</td>
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<td>DCLS 844 Advanced Immunohematology</td>
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<td>DCLS 851 Clinical Correlations I</td>
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<td>BIOS 704 Principles of Statistics in Public Health</td>
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<td>HP&amp;M 810 Health Care System</td>
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<td>PHSL 843 Physiology of Disease</td>
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<td>PRVM 800 Principles of Epidemiology</td>
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DCLS 911 DCLS Residency I  4  
DCLS 912 DCLS Residency II  5  
DCLS 913 DCLS Residency III  5  
* DCLS 800 will be taken during each residency semester.  

Degree requirements and course descriptions are subject to change. Any courses taken as an equivalent must be approved by the Graduate Director and the Office of Graduate Studies. In most cases, use the catalog of the year student entered the program. Other years' catalogs are available (http://catalog.ku.edu/archives).  

Degree requirements and course descriptions are subject to change. Any courses taken as an equivalent must be approved by the Graduate Director and the Office of Graduate Studies. In most cases, use the catalog of the year student entered the program. Other years' catalogs are available (http://catalog.ku.edu/archives).  

The DCLS is a 76 credit hour program designed to be completed in a three year time frame if enrolled full time (see program progression below, part-time options are available). Course work is divided between the "Core Curriculum" (advanced theory courses) completed in the first four semesters of full-time study, and one full year of full-time clinical residency (during which research and residency courses are completed).  

A recommended plan of study for full-time students in the DCLS program is shown below.  

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<tr>
<th>Year 1</th>
<th>Hours</th>
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<td>DCLS 805</td>
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DCLS courses for Years 2 and 3 have been approved and are in development.  

Graduates of the clinical laboratory science doctoral program must have the knowledge and skills to function in a broad variety of clinical laboratory and patient care environments, including hospitals, reference, public health, and physician office settings. Therefore, the following abilities and expectations must be met by all students in the program.  

**Essential Observational Requirements**  
1. Read and comprehend text, numbers, and graphs displayed in print and other visual displays.  
2. Perform comparative observations of text, movement, shapes, graphs, colors, etc.  
3. Observe and respond to subtle cues of individual's moods, temperament, and social behavior.  
4. Observe, learn from, and analyze medical record content, including discernment and use of clinical and administrative data displayed within the medical record.  
5. Observe, learn from, and analyze statistical, financial, and reimbursement data, including utilizing spreadsheets, software, databases, and performing mathematical calculations.  
6. Observe, learn from, and analyze class demonstrations and experiences in disciplines relevant to Clinical Laboratory Sciences that include but are not limited to information management, biochemistry, physiology, statistics, clinical correlations, and research methodology.  

**Essential Movement Requirements**  
1. Perform actions requiring coordination of both gross and fine muscular movement, equilibrium and use of senses.  
2. Move freely and safely about healthcare settings (hospitals, patient rooms, clinics, laboratory, etc.).  
3. Travel to sites both on and off campus involved in coursework and residency.  
4. Perform moderately taxing continuous physical work over several hours.  
5. Use an electronic keyboard to generate, calculate, record, evaluate, and transmit information.  
6. Prepare assignments, both written and on-line.  
7. Deliver public presentations to large and small audiences.  

**Essential Communication Requirements**  
1. Read, interpret, and comprehend technical and professional materials (e.g., textbooks, journal articles, handbooks, instruction manuals, and patient healthcare records).  
2. Be able to share and to elicit information from patients, healthcare providers, peers, and research collaborators verbally and in a recorded format.  
3. Assimilate information to prepare papers, produce reports, and complete documentation for patient care and research purposes.
4. Effectively, confidently, sensitively, and confidentially communicate with patients, laboratory staff, and healthcare providers regarding laboratory test selection, interpretation, and follow-up.

5. Communicate effectively (speaking, writing, typing, graphics, or telecommunication) with faculty, students, laboratory staff, patients, and other healthcare professionals.

6. Take paper and computer examinations.

Essential Intellectual Requirements.

1. Understand and perform measurements, calculations, synthesis, analysis, reasoning and problem solving.

2. Participate in research activities involving the laboratory or patient oriented research activities.

3. Possess sufficient judgment to recognize and correct performance deviations.

Essential Behavioral and Social Requirements

1. Manage the use of time and be able to systematize actions in order to complete academic, professional and technical tasks within realistic constraints.

2. Possess the emotional health necessary to effectively employ intellect, act ethically, and exercise appropriate judgment.

3. Demonstrate appropriate affective behaviors and mental attitudes as to not jeopardize the emotional, physical, mental and behavioral safety of other individuals with whom there is interaction in academic clinical, and residency settings.

4. Possess the mental and emotional rigor to maintain relationships and demonstrate respect to all people, including students, faculty, patients, and other healthcare professionals at residency settings, without showing bias or preference on the basis of race, color, age, sex, religion or creed, national origin or ancestry, gender expression, gender identity, disability, veteran status, sexual orientation or genetic testing & screening.

5. Adapt to professional and technical change, being flexible and creative.

6. Use appropriate language.

7. Demonstrate empathy when appropriate.

8. Work effectively in inter-professional teams.

9. Demonstrate an understanding of the rationale and justification for one’s performance.

10. Demonstrate attention to detail and flexibility to function in a clinical and/or research setting.

11. Recognize potentially hazardous materials, equipment, and situations and proceed safely in order to minimize risk of injury to self and nearby individuals.

12. Practice honesty, compassion, and responsibility.

13. Be forthright about errors or uncertainty.

14. Critically evaluate one’s own performance, accept constructive criticism, and look for ways to improve.

15. Critically evaluate the performance of students, patients, and healthcare providers, tactfully offering constructive comments.

16. Provide professional and technical services while experiencing the stresses of heavy workloads (i.e., large number of tasks to complete in a limited amount of time), task-related uncertainty (i.e., ambiguous test-ordering, ambivalent test interpretation), emergent demands (i.e., “stat” test orders, interaction with other members of the healthcare team), and a distracting environment (i.e., high noise levels, crowding, complex visual stimuli).