

CLINICAL LABORATORY SCIENCES, BACHELOR OF SCIENCE (B.S.)

Clinical laboratory scientists receive training in the following areas: clinical chemistry, the study of chemical reactions that occur in normal and diseased processes; hematology, the study of the cellular elements of the blood and blood-forming tissues and hemostatic mechanism; urine and body fluids analysis, the study of principles and practices of urinalysis, kidney function, and analyses of cerebrospinal fluid and other body fluids; microbiology, the study of microbiological aspects of infectious disease and the isolation and identification of pathogenic bacteria; immunohematology, the application of theory and principles of blood banking, cell typing, compatibility testing and antibody identification; and immunology, the study of the immune system and the serological and molecular techniques used for diagnosing infectious disease. With the rapid advancement of knowledge in the field of laboratory medicine, there is a growing need for highly skilled and knowledgeable clinical laboratory scientists. Employment is found in hospitals; physicians' offices; research facilities; molecular diagnostics, biotechnology and public health laboratories; industrial quality control; veterinary clinics; and sales and service of health care equipment. In addition to the technical arena, opportunities as managers or consultants exist for graduates of this program.

Upon graduation the student is eligible to take the national examination for medical laboratory science given by the Board of Certification of the American Society for Clinical Pathology.

Mission statement

The mission of the undergraduate program is to serve the health care needs of the community by providing highly competent and professional clinical laboratory scientists who will be able to function effectively upon entrance into the field and be prepared to explore future scientific and technological advances in laboratory science.

Learning outcomes

Upon completing this program, students will demonstrate knowledge and proficiency of the following:

- Basic underlying scientific concepts and proficiency in performing the full range of laboratory tests in the areas of hematology, clinical chemistry, immunohematology (blood banking), microbiology, urine and body fluids, serology/immunology, and molecular diagnostics
- Appropriate professional conduct and leadership characteristics to include effective communication skills, ethical conduct and problem-solving abilities.

Admission requirements for applicants with an associate degree in laboratory science

Certified MLTs (CLTs) qualify for special admission with less than 60 hours of credit. An MLT (CLT) applicant must have a minimum of 44 non-MLT semester hours of transferable credit for admission as a full-time student (38 hours for part-time admission). The transfer hours must include: 8 hours of biology, 8 hours of chemistry, 3 hours of mathematics and 6 hours of English composition. MLTs admitted under special status

are required to complete the science, humanities and social sciences requirements for regular admission before they qualify for graduation.

CLS credit may be granted for upper-level course requirements through challenge examinations or exemptions based on documented competencies, depending upon a student's past academic performance in previous course work and clinical experience.

MLTs (CLTs) who meet the exemption eligibility requirements for the junior-level laboratory portions of the curriculum may take the CLS course work online.

Academic regulations

The minimum passing grade for all professional courses leading to the Bachelor of Science degree is D. All courses must be completed with a passing grade, with no more than one D, for the student to be eligible for promotion or graduation. Satisfactory completion of the previous semester's course work is a prerequisite to the next semester.

Promotion/graduation is based on recommendations of the faculty. The student is expected to do all of the following:

- Maintain a minimum GPA of 2.0 at VCU
- Maintain a minimum GPA of 2.0 in CLS course work
- Obtain a passing grade in all CLS courses, with no more than one course grade of D in CLS course work
- Complete the clinical education requirements to the satisfaction of the clinical and academic faculty
- Exhibit the attitudes and skills deemed necessary to function as a professional clinical laboratory scientist
- Pay all fees

Detailed grading policies including the mechanism for grade appeals are given to each entering student during orientation.

Special requirements

All students will have fulfilled core and general education requirements and a minimum of 60 transferable semester credits at an accredited college or university including:

- Biology: 12 hours to include general biology; human physiology and anatomy recommended
- Chemistry: 12 hours to include eight hours of general chemistry; remaining four hours can be (in order of preference) quantitative analysis, organic chemistry or qualitative analysis
- English: six to nine hours of composition (VCU: UNIV 111-UNIV 112 and UNIV 200 or their equivalents)
- Mathematics: three hours; additional mathematics or physics recommended
- Humanities/arts: three hours (selected from courses in history, philosophy, political science, religion, foreign languages, literature, art history or art appreciation)
- Social sciences: three hours (selected from courses in anthropology, economics, geography, psychology or sociology)

Applicants should possess the following essential technical abilities and skills for admission consideration:

- Manual dexterity: ability to use hand(s) or prosthetic devices with coordination

- Fine motor: ability to manipulate small objects with fingertips or adaptive devices
- Mobility: ability to maneuver in the laboratory and around instruments and in patient-care settings
- Vision: ability to distinguish red, yellow and blue colors; to distinguish clear from cloudy; and to distinguish objects through a microscope
- Hearing: ability to hear with assistive devices (i.e., phone receivers, hearing aid, etc.)
- Speech: ability to verbally communicate in English
- Writing: ability to communicate effectively in written form in English
- Reading: ability to read, understand and follow directions printed in English
- Emotional and physical stability: ability to work accurately and safely under stress, adapt to changing environments and prioritize tasks
- Personal attributes: must demonstrate integrity, responsibility, tolerance and respect

Degree requirements for Clinical Laboratory Sciences, Bachelor of Science (B.S.)

Minimum credits for admission into program 60 credits

Major requirements

Course	Title	Hours
CLLS 301	Hematology	3-7.5
& CLLS 302	and Abnormal Hematology	
CLLS 304	Urine and Body Fluid Analysis	1-2
CLLS 306	Immunochemistry	2.5-4.5
CLLS 307	Introduction to Pathogenic Microbiology	1-3
CLLS 308	Pathogenic Bacteriology	3-5
CLLS 310	Clinical Immunology	3-4.5
CLLS 311	Clinical Chemistry and Instrumentation I	3-5
CLLS 312	Clinical Chemistry and Instrumentation II	4-5
CLLS 337	Clinical Education	1
CLLS 407	Interpretive Immunochemistry	2-2.5
CLLS 408	Advanced Microbiology	2
CLLS 409	Interpretive Hematology	2
CLLS 410	Advanced Clinical Chemistry and Instrumentation	2
CLLS 411	Principles of Education/Management	2.5-3.5
CLLS 412	Senior Seminar	1
CLLS 483	Biochemistry Practicum	1-4.5
CLLS 485	Hematology Practicum	1-4.5
CLLS 493	Clinical Microbiology Practicum	1-4.5
CLLS 494	Miscellaneous Clinical Practicum	1-4.5
CLLS 496	Blood Bank Practicum	1-4.5

Elective study

Course	Title	Hours
CLLS 438	Research Paper	1

The minimum total of credit hours required for this degree is 125.

What follows is a sample plan that meets the prescribed requirements within a four-year course of study at VCU. Please contact your adviser before beginning course work toward a degree.

The minimum number of credits for admission into the program is 60.

Junior year

Fall semester		Hours
CLLS 301	Hematology	1.5-3.5
CLLS 304	Urine and Body Fluid Analysis	1-2
CLLS 307	Introduction to Pathogenic Microbiology	1-3
CLLS 310	Clinical Immunology	3-4.5
CLLS 311	Clinical Chemistry and Instrumentation I	3-5
Term Hours:		9.5-18

Spring semester

CLLS 302	Abnormal Hematology	1.5-4
CLLS 306	Immunochemistry	2.5-4.5
CLLS 308	Pathogenic Bacteriology	3-5
CLLS 312	Clinical Chemistry and Instrumentation II	4-5
Term Hours:		11-18.5

Summer semester

CLLS 337	Clinical Education	1
Term Hours:		1

Senior year

Fall semester

CLLS 483	Biochemistry Practicum	1-4.5
CLLS 485	Hematology Practicum	1-4.5
CLLS 493	Clinical Microbiology Practicum	1-4.5
CLLS 494	Miscellaneous Clinical Practicum	1-4.5
CLLS 496	Blood Bank Practicum	1-4.5
Term Hours:		5-22.5

Spring semester

CLLS 407	Interpretive Immunochemistry	2-2.5
CLLS 408	Advanced Microbiology	2
CLLS 409	Interpretive Hematology	2
CLLS 410	Advanced Clinical Chemistry and Instrumentation	2
CLLS 411	Principles of Education/Management	2.5-3.5
CLLS 412	Senior Seminar	1
CLLS 438	Research Paper (elective study)	1
Term Hours:		12.5-14
Total Hours:		39-74

The minimum total of credit hours required for this degree is 125.

CLLS 201. Introduction to Clinical Laboratory Science. 1 Hour.

Semester course; 1 lecture hour. 1 credit. Open to students on the Monroe Park Campus who are interested in clinical laboratory science/medical technology as a career. Presentation and discussion of clinical laboratory science including an introduction to each of the specific areas of concentration, job opportunities in the profession and a tour of a hospital laboratory. Graded as pass/fail.

CLLS 300. Basic Concepts. 1.5 Hour.

Semester course; 1 lecture and 1 laboratory hours. 1.5 credits. An introduction to the basic concepts/techniques applicable to all laboratory science areas. Includes optical physics, quality control, laboratory safety, medical terminology and pipetting techniques along with other basic subjects.

CLLS 301. Hematology. 1.5-3.5 Hours.

Semester course; 2 lecture and 3 laboratory hours. 1.5-3.5 credits. May be repeated for 3.5 credits. Enrollment restricted to CLS majors. Provides a study of the blood and blood-forming tissues. Focuses on basic hematologic techniques and accurate identification of normal and abnormal hematologic cells. Introduces the hemostatic mechanism. Correlates the roles of normal hematologic cells with normal hematologic homeostasis. This course qualifies for the option of proficiency credits for certified medical laboratory technicians.

CLLS 302. Abnormal Hematology. 1.5-4 Hours.

Semester course; 2.5 lecture and 3 laboratory hours. 1.5-4 credits. May be repeated for a total of 4 credits. Prerequisite: CLLS 301. Enrollment restricted to CLS majors. Provides a study of the blood and blood-forming tissues. Focuses on basic hematologic techniques and normal and abnormal cell identification accuracy. Correlates the roles of abnormal cells with pathological conditions. Focuses on abnormal hemostasis. This course qualifies for the option of proficiency credits for certified medical laboratory technicians.

CLLS 304. Urine and Body Fluid Analysis. 1-2 Hours.

Semester course; 1.5 lecture and 1 laboratory hours. 1-2 credits. A study of the principles and practices of urinalysis, kidney function, cerebrospinal fluid and other body fluids.

CLLS 306. Immunohematology. 2.5-4.5 Hours.

Semester course; 2.5 lecture and 4 laboratory hours. 2.5-4.5 credits. Prerequisite: CLLS 310. A study of the theory and principles of blood banking with an emphasis on methods and techniques used in the laboratory for cell typing, cross-matching and antibody identification.

CLLS 307. Introduction to Pathogenic Microbiology. 1-3 Hours.

Semester course; 3 lecture hours. 1-3 credits. May be taken as 1 credit each for study of basic parasitology, mycology or virology. Includes fundamentals of parasites, fungi and viruses as potentially pathogenic microorganisms.

CLLS 308. Pathogenic Bacteriology. 3-5 Hours.

Semester course; 3 lecture hours and 4 laboratory hours. 3-5 credits. Emphasis is placed on pathogenic bacteria, techniques, pathogenesis, epidemiology, isolation and identification, and antimicrobial susceptibility testing.

CLLS 310. Clinical Immunology. 3-4.5 Hours.

Semester course; 3.5 lecture and 2 laboratory hours. 3-4.5 credits. Introduces the basic principles of immunology, serology and molecular diagnostics. Emphasis is placed on laboratory evaluation of the immune response including both cellular and humoral aspects. Serologic techniques are practiced in the laboratory sessions.

CLLS 311. Clinical Chemistry and Instrumentation I. 3-5 Hours.

Semester course; 3 lecture and 4 laboratory hours. 3-5 credits. A study of human physiology and metabolism in health and various disease states. Topics include energy and nitrogen metabolism and proteins in body fluids. Emphasis is placed on the application of quantitative analytical methods and instrumentation for the chemical characterization of body fluids to provide clinically useful information for the diagnosis and treatment of diseases.

CLLS 312. Clinical Chemistry and Instrumentation II. 4-5 Hours.

Semester course; 4 lecture and 2 laboratory hours. 4-5 credits. Prerequisite: CLLS 311 or permission of the instructor. A study of human physiology and metabolism in health and various disease states. Topics include water and ion balance, clinical enzymology, therapeutic drug monitoring, and toxicology. Emphasis is placed on the application of quantitative analytical methods and instrumentation for the chemical characterization of body fluids to provide clinically useful information for the diagnosis and treatment of diseases.

CLLS 337. Clinical Education. 1 Hour.

Semester course; 120 clock hours. 1 credit. Supervised clinical experience in hospitals across the state is designed to give the student a broader clinical education and to provide venipuncture experience. In addition to the application of academically acquired knowledge, this affiliation provides an opportunity for the student to correlate each area of study into one composite picture for final laboratory diagnosis. Closer working relationships with other allied health personnel is an important aspect of this affiliation. Graded as pass/fail.

CLLS 407. Interpretive Immunohematology. 2-2.5 Hours.

Semester course; 2.5 lecture hours. 2-2.5 credits. Prerequisites: CLLS 306 and 310, or permission of instructor. Advanced study of the principles of immunohematology and immunology with major emphasis on blood group systems and blood components. Includes the application of laboratory data and techniques to solve problems in blood banking and immunology.

CLLS 408. Advanced Microbiology. 2 Hours.

Semester course; 2 lecture hours. 2 credits. Prerequisites: CLLS 307 and 308, or permission of instructor. Advanced study of the principles of pathogenic microbiology. Includes the application of laboratory data and techniques to solve problems in the clinical microbiology laboratory.

CLLS 409. Interpretive Hematology. 2 Hours.

Semester course; 2 lecture hours. 2 credits. Prerequisites: CLLS 301-302 and 485, or permission of instructor. Advanced study of the principles of hematopoiesis and their pathophysiological correlation to hematological disorders. Interpretation of morphological findings are correlated with case histories. Includes homeostatic problems.

CLLS 410. Advanced Clinical Chemistry and Instrumentation. 2 Hours.

Semester course; 2 lecture hours. 2 credits. Prerequisites: CLLS 311-312, or permission of instructor. Presents an advanced study of (1) the principles of clinical chemistry as related to intermediary metabolism and pathology and (2) laboratory and hospital information systems. Includes the application of laboratory data and technologies to solve problems in analytical methods and instruments.

CLLS 411. Principles of Education/Management. 2.5-3.5 Hours.

Semester course; 3 lecture hours. 2.5-3.5 credits. Introduces fundamental educational theories and practice, principles of management and employee relations and health-care issues from a global perspective with an emphasis on multicultural diversity. Stresses the application of these theories in the clinical laboratory.

CLLS 412. Senior Seminar. 1 Hour.

Semester course; 1 lecture hour. 1 credit. Seminars are presented on various aspects of professionalism, experimental design and critical evaluation of scientific literature. A simulated registry exam is given at the conclusion. Graded as pass/fail.

CLLS 415. Special Topics in Clinical Laboratory Sciences. 1-6 Hours.

Semester course; 1-6 credits. Course provides for tutorial studies, laboratory experience and/or library assignments in specialized areas for those students who have previous course work or laboratory experience in a specific subject.

CLLS 438. Research Paper. 1 Hour.

Semester course; 1 lecture hour. 1 credit. This course is designed to introduce the student to the fundamentals of scientific writing.

CLLS 483. Biochemistry Practicum. 1-4.5 Hours.

Semester course; 40-180 clock hours. 1-4.5 credits. Prerequisites: CLLS 311-312. Individual participation in hospital chemistry laboratories. Students gain practical experience in the use of procedures and instruments by working with the staff. After gaining competence, students are expected to perform and sign out routine laboratory work under supervision. Graded as pass/fail.

CLLS 485. Hematology Practicum. 1-4.5 Hours.

Semester course; 40-180 clock hours. 1-4.5 credits. Prerequisites: CLLS 301-302. Individual participation in hospital hematology laboratories. Students gain practical experience in the use of procedures and instruments by working with the staff. After gaining competence, the students are expected to perform and sign out routine laboratory work under supervision. Graded as pass/fail.

CLLS 493. Clinical Microbiology Practicum. 1-4.5 Hours.

Semester course; 40-180 clock hours. 1-4.5 credits. Prerequisites: CLLS 307-308. Individual participation in hospital bacteriology laboratories. Students gain practical experience in the performance and use of procedures by working with the clinical staff. After gaining competence, the students are expected to properly perform and sign out routine laboratory work under supervision. Graded as pass/fail.

CLLS 494. Miscellaneous Clinical Practicum. 1-4.5 Hours.

Semester course; 40-180 clock hours. 1-4.5 credits. Prerequisites: CLLS 301-302, 308, 310, 311-312 or permission of instructor. Students gain practical experience in the use of instruments and the performance of procedures by working with the clinical staff. After gaining competence, students are expected to properly perform and sign out routine laboratory work under supervision. Graded as pass/fail.

CLLS 496. Blood Bank Practicum. 1-4.5 Hours.

Semester course; 40-180 clock hours. 1-4.5 credits. Prerequisite: CLLS 306. Individual participation in hospital blood bank laboratories and Virginia Blood Services. Students gain practical experience in the use of procedures and instruments by working with the staff. Donor drawing and component preparation is observed. After gaining competence, the students are expected to properly perform and sign out routine laboratory work under supervision. Graded as pass/fail.