

# Medical Laboratory Science

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## Master of Science in Medical Laboratory Science

Medical Laboratory Scientists are vital healthcare detectives, uncovering and providing key medical information from laboratory analyses that assist physicians in patient diagnosis and treatment, as well as in disease monitoring or prevention.

Laboratory testing encompasses such disciplines as clinical chemistry, hematology, immunology, transfusion medicine, microbiology, and molecular biology.

The Medical Laboratory Science program is located in the Kasiska Division of Health Sciences, College of Health Professions, with campuses in Pocatello, Meridian, and Idaho Falls.

The Master of Science in Medical Laboratory Science degree is designed for either the practicing medical laboratory scientist (certified lab professional) or those students who wish to become certified and then go into leadership positions in administration, education, or specialize in a certain area of pathology/laboratory medicine. Graduates are ideally suited for positions involving teaching, laboratory management, and research. Full-time and part-time options are available, and many courses are available online. A curriculum of coursework and research project is designed and personalized for each student, depending on his/her area of interest and experience.

The Master of Science program in Clinical Laboratory Science requires an original research project that culminates in a thesis or a capstone project, a minimum of 32 credits earned in graduate courses (including research and thesis or capstone project), and expertise in core conceptual areas of Medical Laboratory Science (scientific, administrative, or educational).

### Program Level Student Outcomes:

Upon completion of the ISU Medical Laboratory Science program, students should be able to:

1. Develop, establish, oversee and perform the pre-analytical, analytical, and post-analytical phases of testing on body fluids, cells and other specimens.
2. Ensure appropriate laboratory utilization to optimize full value patient outcomes.
3. Apply statistical analysis of data for use in laboratory epidemiology, examining the relationships of tests to treatment decisions, and to health care outcomes.
4. Establish and use quality assurance and performance measurements to develop solutions to problems and to assure the validity and accuracy of information concerning laboratory data, generated both within and external to the laboratory.
5. Advocate for patients by utilizing the results of laboratory diagnostic procedures and employing algorithms to achieve optimal, full-value patient outcomes.
6. Comply with regulations and guidelines of relevant governmental and non-governmental agencies.

7. Implement laws, regulations and accrediting standards within the operating requirements of the organization to minimize risks and maximize patient outcomes.

### Admission Requirements

Applicants must have a minimum 3.0 GPA for upper-division credits taken at the undergraduate level. Graduate School Admission GPA is calculated based on the last 60± semester undergraduate credits (90± quarter credits). The student must apply to and meet all criteria for admission to the Graduate School. The ISU Graduate School required GRE scores must be met for students with cumulative GPAs under a 3.5.

In addition, admission into the M.S. program will require the student to meet one of the two following conditions:

1. Professionals are already certified as Medical Laboratory Scientist (Board of Certification) and have completed a B.S. or B.A. degree in a related science from an accredited university or college. Note: Categorical certification as Medical Laboratory Scientist does not wholly satisfy this requirement; OR
2. Professionals seek entry-level M.S. completing certification requirements while pursuing the M.S. degree. Completion of a B.S. or B.A. degree from an accredited institution and completion of the following requirements during the M.S. program of study:
  - a. At least 16 semester hours of chemistry to include inorganic chemistry and some combination of organic, biochemistry, and analytical chemistry;
  - b. At least 16 semester hours of biology, to include at least one semester in microbiology, cell biology, genetics, immunology, anatomy and physiology, and human pathophysiology.
  - c. Completion of the ISU Medical Laboratory Science professional program, accredited by NAACLS (National Accrediting Agency for Clinical Laboratory Science). Completion qualifies the applicant to take the national credentialing examinations offered by Board of Certification (BOC) and this should be attempted within one year of finishing the MLS professional block and prior to completion of the MLS research thesis.

### Core Curriculum Areas

The three core areas for Medical Laboratory Science that all students could include in their programs of study are:

1. Scientific subject core area including pathology, hematology, transfusion medicine (immunohematology), clinical chemistry, genetics, microbiology, or molecular biology.
2. Management core area including information management, statistics, Quality Assurance Programs (e.g., Westgard, 6 Sigma Lean), predictive value theory, personnel, financial, organizational, or regulatory concepts.
3. Educational core area including educational design and adult learning for professionals within and outside the medical laboratory setting.

Students are expected to have significant exposure to these core areas by the time they complete their degree requirements. Students coming in with MLS credentials have already demonstrated mastery of the core scientific subject area and those who do not have these credentials will be expected to demonstrate mastery by an examination administered by the program before they finish their M.S. studies.

Students may opt to gain expertise through a variety of mechanisms including independent readings, formal course work, seminars, or special projects. For those students who are not already credentialed, the 6 credits of the MLS Practicum are at the undergraduate level. This does not count toward the 32 graduate credit requirements.

### The Project Process

The MLS Thesis or Capstone Project process comprises the following steps:

1. Meet the minimum qualifications for starting a project
2. Identify a committee
3. Identify a capstone or thesis project
4. Submit a written project proposal describing the project to your faculty advisor
5. Upon approval of the proposal, enroll in capstone or graduate problem/thesis credits
6. Complete the project
7. Upon completion of the project, submit a final project report to your committee
8. Upon approval of the final report, make an oral defense of the project to your committee

### Minimum Qualifications to be eligible to begin the graduate project:

- Route 1: Must have completed at least the 13 required MLS credits.
- Route 2: Must have completed the MLS Professional Block and clinical rotation credits.
- Be in good standing in the MLS program.
- The student must also be a classified degree-seeking student.

### Faculty Advisor:

- Every project must have a faculty advisor. A project faculty advisor must be a member of the MLS faculty and must agree to serve in this role.
- The capstone route requires a faculty advisor and 2 additional faculty committee members.
- The thesis route requires a primary faculty advisor, 1-2 committee members, and a Graduate Faculty Representative (GFR) from outside the MLS department.

### Identify a project:

- Students apply the knowledge gained throughout the program to complete an independent, mentored project.
- The capstone route project must consist of a literature search, and identify a problem or need, that is relevant to the MLS profession or program. This route does not need to be hypothesis-driven. The capstone process culminates in the capstone project being written in a final report and presented as PowerPoint in a defense setting. A viable project should comprise 100-300 working hours. If a student plans to complete the project in one 15-week semester, they should expect to spend approximately 15-20 hours per week actively working on the project.
- The thesis route project requires students to formulate a research question and identify a methodology for obtaining data to test a literature-driven hypothesis. A viable project should collect enough data to write a standard 5-chapter thesis, and draw conclusions about their research questions and hypothesis.

### Proposal:

- A written proposal should be submitted to the MLS faculty advisor. The project proposal should include a cover page, proposed project description, proposed methodology, and project timeline. The MLS advisor should be

given 2 weeks to modify and respond to the proposal. The MLS faculty may accept, accept with modification, or reject the proposal.

### Enrolling in Capstone or Graduate Problems/Thesis credits

- Capstone route: After the approval of the capstone proposal, a student may enroll in 1-3 credits of the Capstone course. A minimum of 3 capstone credits is required for the capstone route degree. A student must be registered for a minimum of one capstone credit in the semester that they defend their project. If the project is not completed at the conclusion of 3 capstone credits, they may register for more than 3 credits. Grades will be submitted as an incomplete grade until after the oral defense, where grade changes will be submitted, if necessary.
- Thesis route: After the approval of the capstone proposal, a student may enroll in up to 4 credits of the Graduate Problems course, and up to 6 credits of the Thesis course. A minimum of 4 Graduate Problems and 6 Thesis credits is required for the thesis route degree. A student must be registered for a minimum of one thesis credit in the semester that they defend their project. If the project is not completed at the conclusion of their 10 required credits, they may register for more than 6 thesis credits. Grades will be submitted as an IP grade until after the oral defense, where grade changes will be submitted, if necessary.

### Complete the project:

- The student should give their MLS faculty advisor regular updates on the progress of the project. It is important for the student to alert their advisor when problems or issues arise that could delay or prevent the completion of the project.

### Final project report:

- The final report should consist of a cover page, executive summary, literature search, methodology, and a critical discussion of project and its implications. As appropriate, the student should draw conclusions and suggest future areas of research. The final project report needs to be submitted to the MLS committee two weeks prior to the oral defense. Thesis route students must complete a written thesis following the ISU Thesis and Dissertation Manual standards published by the Graduate School.

### Oral defense:

- The final step in the project process is to make an oral defense of the project to the MLS committee.

### Scheduling

Scheduling is coordinated by the student, and defenses must be scheduled at least a month in advance of the defense. However, the presentation cannot take place before the final report has been approved. Failure to get approval for your final report will result in the cancellation of the oral defense.

### Time Limitation

Each defense presentation is limited to a total of 50 minutes including introduction, presentation, demonstrations (if any), and questions and answers by the committee. You must leave the last 10 minutes open for questions and answers by the committee, therefore the total time for the student's part of the presentation must be no more than 40 minutes.

### Guests

The oral project defense is a public event and guests may be invited to attend the defense.

### Presentation Content and Format

The oral presentation should be supported with acceptable presentation media that illustrate the major points of the project. The student is expected to explain

the content of the slides, not to read the slides. The slides should focus on the key elements of the project.

**Pass/Fail**

At the conclusion of the oral defense, the MLS committee will vote for pass or fail of the capstone project and final report. To pass the student must get a pass vote from the majority, or 2 of the 3 MLS committee members.

**Route 1 - Previously Certified Students**

**Thesis Track**

Code	Title	Credits
<b>Route 1 - Certified</b>		
<b>Select 3 of the following (minimum 9 credits)</b>		<b>9</b>
MLS 6640	Advanced Topics in Hematology	1-4
MLS 6641	Advanced Topics in Immunology and Transfusion Medicine	1-4
MLS 6642	Advanced Topics in Medical Chemistry	1-4
MLS 6643	Advanced Topics in Medical Laboratory Education	1-4
MLS 6644	Advanced Topics in Medical Microbiology	1-4
MLS 6651	Graduate Seminar	2
<b>Required Thesis Track Courses</b>		
MLS 6648	MLS Graduate Problems	4
MLS 6650	Thesis	6
Graduate electives 5000- or 6000-level		13
<b>Total Credits</b>		<b>32</b>

**Capstone Track**

Code	Title	Credits
<b>Route 1 - Certified</b>		
<b>Select 4 of the following (minimum 13 credits)</b>		<b>13</b>
MLS 6640	Advanced Topics in Hematology	1-4
MLS 6641	Advanced Topics in Immunology and Transfusion Medicine	1-4
MLS 6642	Advanced Topics in Medical Chemistry	1-4
MLS 6643	Advanced Topics in Medical Laboratory Education	1-4
MLS 6644	Advanced Topics in Medical Microbiology	1-4
MLS 6651	Graduate Seminar	2
<b>Required Capstone Track Courses</b>		
MLS 6647	MLS Capstone	3
Graduate electives 5000- or 6000-level		16
<b>Total Credits</b>		<b>32</b>

**Route 2 - Certified Students**

**Thesis Track**

Code	Title	Credits
<b>Route 2 - Uncertified</b>		
<b>Year 1</b>		
<b>Professional Block - Fall</b>		
MLS 4410	Phlebotomy Practicum	1*
MLS 5512	Urinalysis and Body Fluids	1
MLS 5514	Hematology and Hemostasis	3

MLS 5516	Medical Microbiology I	3
MLS 5518	Medical Chemistry and Instrumentation	3
MLS 5520	Medical Immunology	2
MLS 5522	Basic Concepts in Transfusion Medicine	2
MLS 5524	Medical Laboratory Fundamentals	1

**Professional Block - Spring**

MLS 5531	Medical Microbiology II	3
MLS 5533	MLS Management and Education	2
MLS 5535	Molecular Diagnostics	3
MLS 5537	Critical Analysis of Lab Information	3
MLS 5539	Advanced Concepts in Transfusion Medicine	2
MLS 5541	MLS Graduate Research	1-3
MLS 5555	MLS Student Laboratory Practices	2

**Clinical Rotation - Summer**

MLS 4491	Microbiology Practicum	2*
MLS 4492	Hematology and Urinalysis Practicum	2*
MLS 4493	Transfusion Blood Bank Practicum	1*
MLS 4494	Chemistry and Automation Practicum	1*

**Year 2 (+)**

**Select 2 (6 cr) from the following courses:**

MLS 6640	Advanced Topics in Hematology	1-4
MLS 6641	Advanced Topics in Immunology and Transfusion Medicine	1-4
MLS 6642	Advanced Topics in Medical Chemistry	1-4
MLS 6643	Advanced Topics in Medical Laboratory Education	1-4
MLS 6644	Advanced Topics in Medical Microbiology	1-4
MLS 6651	Graduate Seminar	2

**Required Thesis Track Courses**

MLS 6648	MLS Graduate Problems	1-9
MLS 6650	Thesis	1-9

**Credit Hour Totals**

Year 1 (5000 level)	31
Year 2 (6000 level)	16
<b>Total Credits</b>	<b>47</b>

\* Does not count for graduate credit.

**Capstone Track**

Code	Title	Credits
<b>Route 2 - Uncertified</b>		
<b>Year 1</b>		
<b>Professional Block - Fall</b>		
MLS 4410	Phlebotomy Practicum	1*
MLS 5512	Urinalysis and Body Fluids	1
MLS 5514	Hematology and Hemostasis	3
MLS 5516	Medical Microbiology I	3
MLS 5518	Medical Chemistry and Instrumentation	3
MLS 5520	Medical Immunology	2
MLS 5522	Basic Concepts in Transfusion Medicine	2

MLS 5524	Medical Laboratory Fundamentals	1
<b>Professional Block - Spring</b>		
MLS 5531	Medical Microbiology II	3
MLS 5533	MLS Management and Education	2
MLS 5535	Molecular Diagnostics	3
MLS 5537	Critical Analysis of Lab Information	3
MLS 5539	Advanced Concepts in Transfusion Medicine	2
MLS 5541	MLS Graduate Research	1-3
MLS 5555	MLS Student Laboratory Practices	2
<b>Clinical Rotation - Summer</b>		
MLS 4491	Microbiology Practicum	2*
MLS 4492	Hematology and Urinalysis Practicum	2*
MLS 4493	Transfusion Blood Bank Practicum	1*
MLS 4494	Chemistry and Automation Practicum	1*
<b>Year 2 (+)</b>		
<b>Select 3 (9 cr) from the following courses:</b>		
MLS 6640	Advanced Topics in Hematology	1-4
MLS 6641	Advanced Topics in Immunology and Transfusion Medicine	1-4
MLS 6642	Advanced Topics in Medical Chemistry	1-4
MLS 6643	Advanced Topics in Medical Laboratory Education	1-4
MLS 6644	Advanced Topics in Medical Microbiology	1-4
MLS 6651	Graduate Seminar	2
<b>Required Capstone Track Courses</b>		
MLS 6647	MLS Capstone	3
Graduate electives 6000-level		4
<b>Credit Hour Totals</b>		
Year 1 (5000 level)		31
Year 2 (6000 level)		16
<b>Total Credits</b>		<b>47</b>

\* Does not count for graduate credit.

The remaining credits are to be taken from graduate-level courses (a minimum of 16 at the 6000 level) in one or more of the core areas with the approval of the applicant's committee and MLS Program Director.

Three graduate-level courses (6 to 9 credits) approved by the graduate student's committee may be taken from outside the department (to be taken at Boise State University, Idaho State University, or another approved university) and may include adult education, management, and/or medical informatics.

The capstone project may be in a core scientific subject, management, education, or a combination thereof.

## Courses

### **MLS 5512 Urinalysis and Body Fluids: 1 semester hour.**

Fundamental principles of urine and body fluid analysis with correlation of laboratory methods and practice. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5514 Hematology and Hemostasis: 3 semester hours.**

Theoretical and applied aspects of medical hematology and hemostasis with emphasis on recognition and correlation of abnormal laboratory observations with pathological conditions. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5516 Medical Microbiology I: 3 semester hours.**

Study and identification of medically important bacteria, viruses, fungi, chlamydiae, rickettsiae, and parasites as applicable to laboratory and infection control settings. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: BIOL 2235 or BIOL 2221 or equivalent and acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5518 Medical Chemistry and Instrumentation: 3 semester hours.**

Theoretical and applied aspects of medical chemistry with emphasis on test development, validation, and use in diagnosis and management of pathological conditions. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5520 Medical Immunology: 2 semester hours.**

Practical aspects of immunology with emphasis on pathological conditions and laboratory practice. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5522 Basic Concepts in Transfusion Medicine: 2 semester hours.**

Practical aspects and theoretical considerations of major blood groups with respect to transfusion therapy. Oral and written project presentation required for graduate credit. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5524 Medical Laboratory Fundamentals: 1 semester hour.**

Theory and application of basic techniques and instruments used in all areas of medical laboratories. Graduate students will evaluate laboratory methods and write standard operating procedures. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee. Lab fee.

### **MLS 5531 Medical Microbiology II: 3 semester hours.**

Advanced topics in medical microbiology, including application of laboratory techniques to the identification and evaluation of medically important pathogens, and correlations with disease states. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: MLS 5516 and acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5533 MLS Management and Education: 2 semester hours.**

Advanced principles of current personnel, financial, regulatory issues, laboratory information systems, management, and education. Student presentations will be required. Students taking the course for graduate credit will prepare, conduct, and evaluate a project. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5535 Molecular Diagnostics: 3 semester hours.**

A comprehensive overview of the fundamental principles of medical molecular diagnostics and use of molecular techniques in the diagnosis of disease. Topics include: Nucleic acid structure and function, genetics, DNA chemistry, introduction to nucleic acid isolation, identification and amplification techniques. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

### **MLS 5537 Critical Analysis of Lab Information: 3 semester hours.**

Evaluation of clinical laboratory values with emphasis on advanced methods, specialized statistics, algorithm building, and clinical correlations. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

**MLS 5539 Advanced Concepts in Transfusion Medicine: 2 semester hours.**

Advanced topics in Immunohematology. Application of laboratory techniques to the identification and evaluation of antibodies and antigens. Emphasis on transfusion therapy. Graduate students will prepare, conduct, and evaluate case study sessions. PREREQ: MLS 5522 and acceptance into the Medical Laboratory Science program. Professional fee.

**MLS 5541 MLS Graduate Research: 1-3 semester hours.**

Individual theory and application of related topics associated with the medical laboratory. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee.

**MLS 5555 MLS Student Laboratory Practices: 2 semester hours.**

Directed practice in the advanced tests and techniques in common use in the medical laboratory (including molecular biology, microbiology, hematology, chemistry, blood bank). Graduate students will be responsible for higher complexity testing and advanced problem solving exercises. PREREQ: Acceptance into the Medical Laboratory Science program. Professional fee. Lab fee.

**MLS 6640 Advanced Topics in Hematology: 1-4 semester hours.**

Current research and practice in hematology and hemostasis including molecular approaches to medical diagnosis and treatment. May be repeated for a maximum of 4 credits.

**MLS 6641 Advanced Topics in Immunology and Transfusion Medicine: 1-4 semester hours.**

Current research and practice in immunology and transfusion medicine including molecular approach to diagnosis and treatment. May be repeated for a maximum of 4 credits.

**MLS 6642 Advanced Topics in Medical Chemistry: 1-4 semester hours.**

Current research and practice in medical chemistry including innovative instrumentation and molecular diagnostics. May be repeated for a maximum of 4 credits.

**MLS 6643 Advanced Topics in Medical Laboratory Education: 1-4 semester hours.**

Curriculum design and evaluation in the Medical Laboratory setting. May be repeated for a maximum of 4 credits.

**MLS 6644 Advanced Topics in Medical Microbiology: 1-4 semester hours.**

Current research in microbiology and molecular diagnostics including the molecular basis of important infectious diseases, microbial pathogenesis, and host-pathogen interactions. May be repeated for a maximum of 4 credits.

**MLS 6647 MLS Capstone: 1-6 semester hours.**

Completion of a Medical Laboratory Science project. Practical application of a knowledge/skill in laboratory practice, management, or education. May be repeated for a total of 6 credits. Graded S/U. Prerequisite: Acceptance into the Medical Laboratory Science program. Professional fee.

**MLS 6648 MLS Graduate Problems: 1-9 semester hours.**

Thesis-related research. May be repeated. Graded S/U. PREREQ: Graduate standing and permission of instructor.

**MLS 6650 Thesis: 1-9 semester hours.**

Thesis-related research. May be repeated. Graded S/U. PREREQ: Graduate standing and permission of instructor.

**MLS 6651 Graduate Seminar: 2 semester hours.**

An online elective graduate course for students admitted into the Medical Laboratory Science program.

**MLS 6699 Experimental Course: 1-6 semester hours.**

The content of this course is not described in the catalog. Title and number of credits are announced in the Class Schedule. Experimental courses may be offered no more than three times with the same title and content. May be repeated.