MEDICAL LABORATORY SCIENCE, BS

Banner Code: SC-BS-MLAB

Academic Advising
1200 Exploratory Hall
Fairfax Campus
Website: biology.gmu.edu/academics/degree-programs/

The BS in Medical Laboratory Science prepares students for careers in hospitals and clinics as well as in biotechnology and industrial laboratories. Medical Laboratory Science (MLS) is a profession of highly knowledgeable and skilled individuals who perform clinical laboratory tests on blood, other body fluids, or tissue samples. This is a critical part of health care, as the results obtained by these laboratory tests are vital tools for physicians in the diagnosis, treatment, and prevention of disease.

People trained as medical laboratory scientists may work in a variety of settings. Many work in clinical laboratories in large medical centers, hospitals, or clinics. Some do research in industrial, public health, or medical laboratories. Others teach in hospitals, colleges, or universities. An MLS may practice as a generalist, using knowledge in several of the scientific disciplines, or may specialize in one scientific area in larger hospitals. A successful MLS is an individual who enjoys studying the biological, chemical, and physical sciences. He or she may also find personal satisfaction and intellectual reward in applying scientific methods to the diagnosis and evaluation of disease.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Undergraduate Admissions Policies section of this catalog.

To apply for this program, please complete the George Mason University Admissions Application (https://www2.gmu.edu/admissions-aid/apply-now).

Policies

Students must fulfill all Requirements for Bachelor’s Degrees including the Mason Core. MLAB 300 Science Writing fulfills this major’s writing intensive requirement.

Important information and departmental policies are available with the Department of Biology.

This program requires the equivalent of three years of full-time pre-professional study at the college level preceding a senior year of professional education in an affiliated program of medical laboratory science. Affiliated schools (see below) are accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) (http://www.naacls.org/Home.aspx). Quest Diagnostics (http://www.questdiagnostics.com/home.html) in Chantilly, Virginia also provides professional education for this program.

Important Program Requirements

• Students must complete MLAB 200 Introduction to Medical Laboratory Science and present their biology coursework and supporting requirements with a minimum GPA of 2.00.
• A grade of ‘C’ or better must be earned in BIOL 213 Cell Structure and Function (Mason Core) in order to advance to other major requirements. Students may repeat BIOL 213 Cell Structure and Function (Mason Core) once and a second time only with permission of the Department of Biology.
• Medical laboratory science majors must earn a minimum of ‘C’ in all biology core courses.

Major in Medical Laboratory Science as a Second Bachelor’s Degree

While the standard program for medical laboratory sciences is three years on campus followed by a fourth year at a clinical affiliate (3+1), many students elect to complete a bachelor’s degree before entering the clinical program (4+1). Students who have completed the Biology, BS or Chemistry, BS at Mason and then undertake a fifth year at a clinical affiliate may be eligible for a second bachelor’s degree with a major in medical laboratory science. Students wishing to receive the second degree must apply before entering their fifth year. For further information, contact a laboratory sciences advisor.

Applying to Medical Laboratory Sciences Schools

Responsibility for applying to schools of medical laboratory sciences and gaining admission rests with the student; however, guidance is provided by the medical laboratory sciences program director. Admission to medical laboratory sciences schools is competitive, so candidates should strive for strong academic standing (2.5 science GPA or higher). Students who fail to gain admission to a NAACLS-approved school are unable to complete this degree program. Such students may transfer to Biology, BA or the Biology, BS without loss of credits.

Application to medical laboratory sciences schools should be initiated about a year before the desired entrance date. This fact, coupled with the large number of required courses in the pre-professional curriculum, makes it imperative that students in the program consult regularly with their faculty advisor. All medical laboratory sciences majors and prospective majors are urged to enroll in MLAB 200 Introduction to Medical Laboratory Science as early as possible. This course provides information on the profession, as well as the educational demands placed on candidates.

Senior Year

Students should be aware that the senior year spent off campus requires the following special interpretation of university policies:

• Students may present no more than 6 credits of ‘D’ grades in biology and chemistry courses required in three years of pre-professional study.
• No unsatisfactory grades (less than ‘C’) may be presented for courses in the senior year of professional study.

1 Note: Because of the extensive pre-professional education requirements stipulated by NAACLS, students majoring in medical laboratory science are exempt from the Mason Core ‘Arts’ requirement.
• Transfer students must present at least 16 credits of 300 to 400-level biology or chemistry coursework taken at Mason.
• Transfer students entering with more than 45 transfer credits are often unable to complete the pre-professional phase of their program in the usual three years of full-time study.

Senior students are registered at the university through special procedures. For details, consult the program director.

Affiliated NAACLS-Approved Schools
This program requires the equivalent of three years of full time professional study at the college level preceding a senior year of professional education in an affiliated school of medical laboratory sciences. All affiliated schools are accredited by the NAACLS:

• Augusta Health- School of Clinical Laboratory Science (https://www.augustahealth.com/clsl)
• George Washington University- School of Medicine and Health Sciences: The Medical Laboratory Sciences Program (http://smhs.gwu.edu/medical-laboratory-sciences)
• INOVA Fairfax Hospital- Medical Laboratory Science Program (https://www.inova.org/education/medical-laboratory-science)
• Sentara Rockingham Memorial Hospital- School of Medical Laboratory Science (https://www.sentara.com/harrisonburg-virginia/hospitalslocations/locations/school-of-medical-laboratory-science.aspx)

Requirements
Degree Requirements
Total credits: minimum 120

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Students must complete the requirements outlined below, choosing one Professional Study/Concentration option:

• Not choosing a concentration (“Professional Study: Generalist Option”) will provide students generalist training. Upon graduation, the board certification test may be taken and would allow graduates to practice in any area of a hospital or laboratory.
• Choosing a concentration will allow students to complete their clinical rotations in that specific area. Upon graduation, the Molecular Biology or Microbiology (depending upon the concentration chosen) board certification test may be taken.

Biology Core

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 213</td>
<td>Cell Structure and Function (Mason Core)</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 214</td>
<td>Biostatistics for Biology Majors</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 311</td>
<td>General Genetics</td>
<td>4</td>
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</table>

Total Credits 12

MLAB and BIOL Additional Courses

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLAB 200</td>
<td>Introduction to Medical Laboratory Science</td>
<td>1</td>
</tr>
<tr>
<td>MLAB 300</td>
<td>Science Writing</td>
<td>2</td>
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</tbody>
</table>

BIOL 305 | Biology of Microorganisms            | 3       |
BIOL 306 | Biology of Microorganisms Laboratory | 1       |
BIOL 430 | Advanced Human Anatomy and Physiology I | 4       |
BIOL 431 | Advanced Human Anatomy and Physiology II | 4       |
BIOL 452 | Immunology                           | 3       |
BIOL 453 | Immunology Laboratory                | 1       |

Total Credits 19

1  Fulfills writing intensive requirement.

Chemistry

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CHEM 211 &amp; CHEM 213</td>
<td>General Chemistry I (Mason Core) and General Chemistry Laboratory I (Mason Core)</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 212 &amp; CHEM 214</td>
<td>General Chemistry II (Mason Core) and General Chemistry Laboratory II (Mason Core)</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 313</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 315</td>
<td>Organic Chemistry Lab I</td>
<td>2</td>
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Select one from the following: 4-5

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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOL 483</td>
<td>General Biochemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 314 &amp; CHEM 318</td>
<td>Organic Chemistry II and Organic Chemistry Lab II</td>
<td></td>
</tr>
</tbody>
</table>

Total Credits 17-18

Mathematics

Select one from the following: 3-6

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 111</td>
<td>Linear Mathematical Modeling (Mason Core)</td>
<td>3</td>
</tr>
</tbody>
</table>

or MATH 113 | Analytic Geometry and Calculus I (Mason Core) | 3       |

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<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 123 &amp; MATH 124</td>
<td>Calculus with Algebra/Trigonometry, Part A and Calculus with Algebra/Trigonometry, Part B (Mason Core)</td>
<td>3</td>
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</tbody>
</table>

Total Credits 3-6

Information Technology

Select one from the following: 3

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDS 130</td>
<td>Computing for Scientists (Mason Core)</td>
<td>3</td>
</tr>
</tbody>
</table>

Any course(s) which fulfills the Mason Core: Information Technology requirement

Total Credits 3

1  Recommended course for this major

Professional Study: Generalist Option
Senior students are registered at the university through special procedures. For details, consult the medical laboratory science program director.
The senior year spent off campus requires the following special interpretation of university policies:

- Transfer students must present at least 16 credits of 300 to 400-level biology or chemistry coursework taken at Mason.
- No unsatisfactory grades (less than 'C') may be presented for courses in the senior year of professional study.
- Transfer students entering with more than 45 transfer credits are often unable to complete the pre-professional phase of their program in the usual three years of full-time study.

Students may have up to 30 credits of professional study during the senior year awarded for clinical education at an affiliated school of medical technology. No more than 30 professional credits may be applied toward the degree.

### Code | Title | Credits
---|---|---
MLAB 401 | Orientation to the Problems and Practices of the Clinical Laboratory | 30
MLAB 402 | Clinical Hematology and Coagulation | 30
MLAB 403 | Clinical Microscopy | 30
MLAB 404 | Serology and Immunohematology | 30
MLAB 405 | Clinical Microbiology | 30
MLAB 406 | Clinical Chemistry | 30
MLAB 407 | Clinical Molecular Biology | 30

### Notes:

Students are encouraged to elect additional basic science courses during their pre-professional years. Recommended courses include:

### Code | Title | Credits
---|---|---
Biol 465 | Histology | 4
Biol 483 | General Biochemistry | 4
Biol 484 | Cell Signaling and Disease | 3
Biol 485 | Cell Signaling Laboratory | 2-3
Chem 321 | Quantitative Chemical Analysis | 4
Phys 243 | College Physics I (Mason Core) | 3
Phys 244 | College Physics I Lab (Mason Core) | 1
Phys 245 | College Physics II (Mason Core) | 3
Phys 246 | College Physics II Lab (Mason Core) | 1

### Professional Study: Microbiology Concentration (MOB)

Senior students are registered at the university through special procedures. For details, consult the medical laboratory science program director.

The senior year spent off campus requires the following special interpretation of university policies:

- Transfer students must present at least 16 credits of 300 to 400-level biology or chemistry coursework taken at Mason.
- No unsatisfactory grades (less than 'C') may be presented for courses in the senior year of professional study.

Students may have up to 30 credits of professional study during the senior year awarded for clinical education at an affiliated school of medical technology. No more than 30 professional credits may be applied toward the degree.

This concentration is a pathway leading to eligibility for categorical certification as a Certified Technologist by the American Society for Clinical Pathology (ASCP) (https://www.ascp.org/content) Board of Certification (BOC) (https://www.ascp.org/content/board-of-certification). The concentration is one year long, consisting of about 20% classroom and 80% hands-on laboratory experience. Instructors include the expert clinical scientists and technologists of Quest Diagnostics (http://www.questdiagnostics.com/home.html) in Chantilly, Virginia.

### Code | Title | Credits
---|---|---
MLAB 401 | Orientation to the Problems and Practices of the Clinical Laboratory | 30
MLAB 407 | Clinical Molecular Biology | 30

### Notes:

Students are encouraged to elect additional basic science courses during their pre-professional years. Recommended courses include:

### Code | Title | Credits
---|---|---
Biol 465 | Histology | 4
Biol 483 | General Biochemistry | 4
Biol 484 | Cell Signaling and Disease | 3
Biol 485 | Cell Signaling Laboratory | 2-3
Chem 321 | Quantitative Chemical Analysis | 4
Phys 243 | College Physics I (Mason Core) | 3
Phys 244 | College Physics I Lab (Mason Core) | 1
Phys 245 | College Physics II (Mason Core) | 3
Phys 246 | College Physics II Lab (Mason Core) | 1

### Professional Study: Microbiology Concentration (MIB)

Senior students are registered at the university through special procedures. For details, consult the medical laboratory science program director.

The senior year spent off campus requires the following special interpretation of university policies:

- Transfer students must present at least 16 credits of 300 to 400-level biology or chemistry coursework taken at Mason.
- No unsatisfactory grades (less than 'C') may be presented for courses in the senior year of professional study.
- Transfer students entering with more than 45 transfer credits are often unable to complete the pre-professional phase of their program in the usual three years of full-time study.

Students may have up to 30 credits of professional study during the senior year awarded for clinical education at an affiliated school of medical technology. No more than 30 professional credits may be applied toward the degree.
medical technology. No more than 30 professional credits may be applied toward the degree.

This concentration is a pathway leading to eligibility for categorical certification as a Certified Technologist by the American Society for Clinical Pathology (ASCP) (https://www.ascp.org/content) Board of Certification (BOC) (https://www.ascp.org/content/board-of-certification). The concentration is one year long, consisting of about 20% classroom and 80% hands-on laboratory experience. Instructors include the expert clinical scientists and technologists of Quest Diagnostics (http://www.questdiagnostics.com/home.html) in Chantilly, Virginia.

### MLAB 401 Topics

The following topics will be covered under MLAB 401 Orientation to the Problems and Practices of the Clinical Laboratory:

1. **Introduction to CLS and Laboratory Operations**
   This course is a brief introduction to the Clinical Laboratory Science professions and Laboratory Operations. Topics include: Introduction to Laboratory Operations, Pre-analytics and Specimen Types, Quality Management Concepts, Quality Control, Laboratory Professions, Professional Ethics, Laboratory Mathematics, Proper use of Laboratory Equipment, Introduction to Laboratory Instrumentation.

2. **Board Exam Preparation**
   This course is a structured review and practice in preparation for the American Society for Clinical Pathology (https://www.ascp.org/content) Technologist in Molecular Biology Board of Certification Exam. Practice tests and questions from a variety of published and authoritative sources are used to reinforce the content of the Technologist in Molecular Biology program.

### MLAB 405 Topics

The following topics are covered under MLAB 405 Clinical Microbiology:

1. **Introduction to Clinical Microbiology**
   This course is a brief introduction to the discipline of Clinical Microbiology, and laboratory diagnostic techniques. Topics include: Overview of Microbiology Theory, Methods and Applications, Instrumentation, Staining, and Media, Immunology, Serology, and Molecular Diagnostics.

2. **Medical Virology**
   This course is a survey of the characteristics, pathogenicity, and laboratory diagnosis of important human viruses. Topics include viral taxonomy and classical virology. Special emphasis is placed on the epidemiology and the laboratory’s role in influenza pandemics.

3. **Medical Mycology**
   This course is a comprehensive presentation of medically important fungi. Emphasis is placed on clinical presentation and laboratory identification of pathogenic species and opportunistic pathogens. Topics include general mycology methods, yeasts, susceptibility testing, molds (Hyaline, Mucor, Dematiaceous), Dermatophytes, Systemic infections, and Pneumocystis.

4. **Medical Parasitology**
   This course is a comprehensive presentation of human parasites. Emphasis is placed on clinical presentation and laboratory identification. This course examines the advances in using molecular methods to detect human infectious disease. Careful attention is given to the comparison of molecular technologies with traditional microbiology methods. Topics include molecular methods and applications, including PCR, sequencing, TMA, and PEGE, specimens of choice, sample preparation, Quality Control, primer selection, Molecular methods in selecting antimicrobial agents, molecular epidemiology, and target organisms: fungi, bacteria, parasites, and viruses.

5. **Molecular Detection of Infectious Disease**
   This course examines the advances in using molecular methods to detect human infectious disease. Careful attention is given to the comparison of molecular technologies with traditional microbiology methods. Topics include molecular methods and applications, including PCR, sequencing, TMA, and PEGE, specimens of choice, sample preparation, Quality Control, primer selection, Molecular methods in selecting antimicrobial agents, molecular epidemiology, and target organisms: fungi, bacteria, parasites, and viruses.

6. **Medical Bacteriology**
   This course is a comprehensive presentation of bacteria isolated in the clinical laboratory. Emphasis is placed on the laboratory identification of isolates from a variety of specimen sources, and pathogenic species. Topics include Instrumentation and MALDI, Gram Positive Cocci, Gram Positive Baccili, Enterics, non-fermenters, Moraxella, Neisseria, Pasteurella, Haemophilus and HACEK, Campylobacter, Helicobacter, Legionella, CDC Select Agents, Chlamydia, Mycoplasma, Ureaplasma, Spirochetes, Anaerobes, Antibiotics and Susceptibility testing, and Acid Fast Bacilli.

7. **Microbiology Clinical Correlations**
   Designed as the capstone for the Technologist in Microbiology program, this course takes a body system view of the pathogenicity of infectious disease. Attention is given to integrating clinical presentation and case history to laboratory investigation and diagnosis. Topics include UTI/
Genital, Food Borne/GI, Cystic Fibrosis, Blood, CSF, Body Fluids, and Wounds.

**MLAB 407 Topics**
The following topics will be covered under MLAB 407 Clinical Molecular Biology:

1. **Introduction to Clinical Molecular Biology**
   This course presents the fundamentals of nucleic acid testing in the clinical laboratory and the underlying human genetics. Topics include: Fundamentals of Nucleic Acid Biochemistry, Common Techniques in Molecular Biology (Extraction, Resolution and Detection of Nucleic Acids, Analysis and Characterization, Amplification, Chromosomal Structure and Mutations, Gene Mutations, and DNA Sequencing).

2. **Advanced Methods in Clinical Molecular Biology**
   This course applies the fundamentals of nucleic acid testing to advanced methods commonly used in the contemporary clinical and research laboratory. Topics include: PCR, Transcription-Based Amplification, Probe Amplification, Branched DNA, Hybrid Capture, Amplification: Signal, Cleavage-Based, Cycling Probe, Sequencing: Direct, Next Gen, Pyrosequencing, Bisulfite, RNA Sequencing, Bioinformatics, Human Genome Project.

3. **Molecular Detection of Infectious Disease**
   This course examines the advances in using molecular methods to detect human infectious disease. Careful attention is given to the comparison of molecular technologies with traditional microbiology methods. Topics include: Molecular methods and applications, including PCR, sequencing, TMA, and PEGE, specimens of choice, sample preparation, Quality Control, primer selection, Molecular methods in selecting antimicrobial agents, molecular epidemiology, and target organisms: fungi, bacteria, parasites, and viruses.

4. **Human Molecular and Chromosomal Applications and Pathology**
   This course presents advanced methods in nucleic acid testing to human medico-legal, forensic, and pathology applications. Topics include: Polymorphisms, RFLP, Paternity Testing, Linkage, Single Nucleotide Polymorphisms, Bone Marrow Engraftment, Mitochondrial DNA Polymorphisms and Disorders, Chromosomal Abnormalities, Patterns of Inheritance, Single Gene Disorders, Lysosomal Storage Disorders, Cystic Fibrosis, Trinucleotide Repeats, Genomic Imprinting, Array CGH, Molecular Oncology, HLA and Transplantation.

**Mason Core and Electives**
In order to meet a minimum of 120 credits, this degree requires an additional 32-36 credits, which may be applied toward any remaining Mason Core requirements (outlined below), Requirements for Bachelor’s Degrees, and electives. Students are strongly encouraged to consult with their advisors to ensure that they fulfill all requirements.

**Mason Core**
Some Mason Core requirements may already be fulfilled by the major requirements listed above. Students are strongly encouraged to consult their advisors to ensure they fulfill all remaining Mason Core requirements.

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Foundation Requirements</td>
<td>Written Communication (ENGH 101)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Oral Communication</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Quantitative Reasoning</td>
<td>3</td>
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**Information Technology and Computing** 3

**Exploration Requirements**

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<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>Arts</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Global Understanding</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Literature</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Natural Science</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Western Civilization/World History</td>
<td></td>
<td>3</td>
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**Integration Requirements**

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<tbody>
<tr>
<td>Written Communications</td>
<td>(ENGH 302)</td>
<td>3</td>
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<tr>
<td>Writing-Intensive</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Synthesis/Capstone</td>
<td></td>
<td>3</td>
</tr>
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</table>

**Total Credits** 40

1 Most programs include the writing-intensive course designated for the major as part of the major requirements; this course is therefore not counted towards the total required for Mason Core.

2 Minimum 3 credits required.