

# CLINICAL LABORATORY SCIENCES

## DEPARTMENT OFFICE

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## Clinical Laboratory Sciences at NMU

The Clinical Laboratory Sciences Department has a strong commitment to the career ladder approach to higher education. All programs and degrees are designed to be transferable to higher-level degrees. All programs are based heavily in the sciences with an application to clinical pathology. Depending on program selection, graduates find employment in hospital laboratories, clinics, industry, microbiology, biotechnology, forensics and research.

The clinical laboratory science field is made up of professionals who rely on their knowledge of basic science and laboratory skills to assume a variety of responsibilities in various laboratory and clinical settings. Graduates of the clinical laboratory sciences curricula must possess appropriate knowledge, skills and attributes to become competent practitioners who are readily adaptable to changing technologies. Advancement opportunities exist for the graduate as specialists, directors, managers and consultants with experience and/or further education.

The clinical laboratory sciences curriculum includes 12 programs: bachelor's degrees include clinical laboratory scientist, clinical laboratory scientist/microbiology concentration, diagnostic genetics, clinical systems analyst, cytotechnology, histotechnology and science technologist. Associate in applied science degrees include clinical laboratory technician, histotechnician and science technician; and certificate programs include clinical assistant and surgical technology. The department also offers a minor program in clinical laboratory techniques.

The university maintains CLS affiliations with a variety of hospitals in Michigan, Wisconsin and Minnesota. A list of the affiliations is available on the department's Web site.

The clinical laboratory science, clinical laboratory technician, diagnostic genetics, histotechnology, clinical assistant and histotechnician programs are accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). The cytotechnology program is accredited by the American Society of Cytology (ASC). The surgical technology program is accredited by the Commission on Accreditation of Allied Health Education (CAAHE).

## Department/Program Policies

Students majoring in clinical systems analyst, cytotechnology, histotechnologist, histotechnician, science technologist and technician, clinical laboratory technician, clinical assistant or minoring in clinical laboratory techniques must maintain a 2.00 grade point average in the major/minor and an NMU cumulative grade point average of 2.00. Students must receive no less than a "C-" in any CLS course for the clinical laboratory technician and clinical assistant program. Based on the chosen major, upon graduation, students are qualified to take a national certification exam in either cytotechnology, histotechnology, histotechnician, CLT or phlebotomy. Additional special criteria and policies for internships are further described in the *CLS Policy Manual*. Students majoring in surgical technology must receive no less than a "C" in all required courses. For specific information on the application process, refer to the *Surgical Technology Student Handbook*.

## Clinical Laboratory Scientist and Clinical Laboratory Scientist/Microbiology

In order to be granted a bachelor's degree as a clinical laboratory scientist, a student must maintain an NMU cumulative grade point average of 2.60 and a 2.00 grade point average in the major. Students must receive no less than a "C-" in any CLS course. Students are eligible to take national certification examinations for clinical laboratory scientists or the microbiology categorical exam upon program completion. Criteria for placement into the practicum can be found under the appropriate course descriptions.

## Diagnostic Genetics

In order to be granted a bachelor's degree in diagnostic genetics, a student must have an NMU cumulative grade point average of 2.60, a grade point average of 2.60 in the major, meet specific course grade requirements, and receive no less than a "C" in any course of the major. Students are then qualified to take the national certification exams for cytogenetics and molecular biology. Criteria for placement into the practicum includes a minimum 2.80 GPA in the major. Other requirements can be found under the appropriate course descriptions.

## Surgical Technology

Students in baccalaureate degree programs may apply up to six credits of surgical technology (ST) courses toward graduation unless otherwise prohibited. Students in associate degree programs may apply three credits of these courses toward graduation, and those in certificate programs other than cosmetology, practical nursing and surgical technology may apply two credits of these courses combined toward graduation unless otherwise prohibited.

### Admission to the Surgical Technology Clinical Program

Admissions to the surgical technology clinical sequence of courses is limited. The Admissions Committee reserves the right to select students to be admitted. Students who have the highest grade point average and pre-admission test scores (if required) will be admitted first until the class is filled. Not all students who have met the minimum standards will be admitted if the space is not available.

To be considered for admission into the surgical technology clinical program a student must meet the following qualifications:

1. Must have met all NMU admission requirements and be in good standing.
2. Must have taken the Pre-Surgical Technology Assessment test and achieved a passing score in all of the subsets of the test if required by the department.
3. Must have a minimum cumulative grade point average of 2.00 (C) in all the prerequisite college courses required in the program with no grade below "C." In addition, students must have a cumulative NMU GPA of 2.00.
4. Must have successfully passed all required nursing/surgical technology courses after a maximum of two tries.

Surgical technology students will be notified of their acceptance into the clinical sequence by December 23.

### Retention in the Surgical Technology Sequence

For a student to remain in the surgical technology sequence he or she must meet the following conditions:

1. Maintain a minimum cumulative grade point average of 2.00 in all surgical technology courses with no course below a "C", and maintain a cumulative Northern Michigan University grade point average of 2.00.
2. Adhere to the university's *Student Code* and *Surgical Technology Student Policies*.
3. Demonstrate a pattern of safe clinical practice commensurate with his or her educational experience to date.

### Surgical Technology Readmission Criteria

Surgical technology courses are sequential, and there is limited space in some courses. When a student wishes to be readmitted into the surgical technology sequence of courses after having a withdrawal or failure in a previously enrolled course, the student

must apply for readmission to the department coordinator.

Students who have failed any surgical technology courses more than once are ineligible for readmission.

## Additional Policies

For further information on policies, essential functions, application procedures, specific affiliation sites, hospital placement eligibility, costs, certification requirements, and job markets, see the *CLS Policy Manual* (available at the Northern Michigan University Bookstore) or the *Surgical Technology Student Handbook* (available in the Surgical Technology Office). The Clinical Laboratory Sciences Department reserves the right to withdraw any student whose health, conduct, scholastic standing or clinical practice is such that it is inadvisable for the student to remain in the department. In any of the programs offered by this department, clinical placement for training cannot be guaranteed. In addition to the academic placement policies, students must be recommended by the departmental faculty. Any negative recommendations may override an otherwise acceptable academic record.

Students majoring in department programs may be required to have certain immunizations. Further information is available in the department office.

## BACHELOR DEGREE PROGRAMS

*Liberal Studies:* Complete information on the liberal studies requirements and additional graduation requirements, including the health promotion requirement, is in the "Liberal Studies Program and Graduation Requirements" section of this bulletin (38-44).

Courses within each major that can be used to satisfy liberal studies requirements are listed with the Roman numeral (in brackets) that coincides with the liberal studies division the course falls under.

### Clinical Laboratory Science Major

This major prepares graduates to perform a variety of laboratory assays on human and other types of specimens in clinical, research, commercial (biotechnology, pharmaceutical, etc.) and forensic laboratories to provide diagnostic data and information necessary to support health care, ensure quality control, facilitate product development and solve problems.

The program incorporates didactic and clinical education throughout the four-year curriculum. Students gain marketable skills after two years in the program through CLT certification. Upon completion of the degree, students are eligible to take one of the national certification tests: CLS/MT Generalist or the Microbiology Categorical. The sophomore and senior practica provide an opportunity for students to experience two different clinical settings prior to graduation.

<b>Total Credits Required for Degree</b>	<b>131</b>
<b>Liberal Studies</b>	<b>30-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Required Courses in Major</b>	<b>61</b>
CLS 100 Obtaining a Blood Specimen	1
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 202 Clinical Chemistry	4
CLS 203 Immunohematology	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
CLS 214 Diagnostic Microbiology	3
CLS 250T Clinical Practice	2
CLS 251 Clinical Hematology Practicum	3
CLS 252 Clinical Chemistry Practicum	4
CLS 253 Blood Banking Practicum	3
CLS 254 Clinical Microbiology Practicum	4
CLS 301 Advanced Hematology/Coagulation	3
CLS 302 Advanced Clinical Chemistry	2
CLS 303 Advanced Immunohematology	2
CLS 304 Advanced Clinical Microbiology	2
CLS 420 Clinical Educational Practices	1
CLS 250S Clinical Practice	1
CLS 451 Advanced Hematology Practicum	3

CLS 452 Advanced Clinical Chemistry Practicum	3
CLS 453 Advanced Clinical Immunohematology Practicum	4
CLS 454 Advanced Microbiology Practicum	4

<b>Other Required Courses</b>	<b>44</b>
BI 104 Human Anatomy and Physiology [III]	4
BI 111 Introductory Biology: Principles [III]	4
BI 206 Human Genetics	3
BI 218 Cell and Molecular Biology	4
BI 405 Immunology	3
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
CH 220 Introductory Organic Chemistry	5
CH 450 Introductory Biochemistry	4
MA 171 Introduction to Probability and Statistics [V]	4
MGT 240 Organizational Behavior and Management	3

### Clinical Laboratory Science–Clinical Microbiology Concentration Microbiology Categorical Certification Option

This program allows CLT graduates an opportunity to focus on microbiology at the baccalaureate level. Graduates are eligible for national certification in the microbiology category and may be employed in hospitals and clinics as well as in research and industrial laboratories.

<b>Total Credits Required for Degree</b>	<b>128</b>
<b>Liberal Studies</b>	<b>33-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Major Core</b>	<b>54</b>
CLS 100 Obtaining a Blood Specimen	1
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 202 Clinical Chemistry	4
CLS 203 Immunohematology	3
CLS 213 Clinical Immunology and Serology	1
CLS 250T-253 Clinical Practicum	12
CLS 420 Clinical Educational Practices	1
<b>Major Concentration</b>	<b>26</b>
CLS 204 Clinical Microbiology	2
CLS 214 Diagnostic Microbiology	3
CLS 254 Clinical Microbiology Practicum	4
CLS 304 Advanced Clinical Microbiology	2
CLS 440 Advanced Clinical Bacteriology	8
CLS 441 Advanced Clinical Mycology	2
CLS 442 Advanced Clinical Parasitology	2
CLS 443 Advanced Clinical Mycobacteriology/ Virology	2
CLS 250M Clinical Practice	1
<b>Supportive Courses for Microbiology</b>	<b>14</b>
BI 303 General Microbiology	5
BI 423 Parasitology	3
BI 404 Virology	3
BI 405 Immunology	3
<b>Other Required Courses</b>	<b>34</b>

BI 104 Human Anatomy and Physiology [III]	4
BI 111 Introductory Biology: Principles [III]	4
BI 206 Human Genetics	3
BI 218 Cell and Molecular Biology	4
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
CH 220 Introductory Organic Chemistry	5
MA 171 Introduction to Probability and Statistics [V]	4

### Clinical Systems Analyst Major

This program prepares graduates to work in a clinical laboratory setting, in a hospital information systems department or as a laboratory information systems consultant. Students receive training and first become certified laboratory professionals at the clinical laboratory technical level. The clinical systems analyst major is augmented with a comprehensive background in computer information systems. There is a pressing need nationwide for skilled computer information systems graduates who understand the unique requirements of a clinical laboratory.

<b>Total Credits Required for Degree</b>	<b>128</b>
<b>Liberal Studies</b>	<b>30-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Required Courses in Major</b>	<b>66-69</b>
<b>CLS Concentration</b>	<b>39-40</b>
CLS 100 Obtaining a Blood Specimen	1
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 202 Clinical Chemistry	4
CLS 203 Immunohematology	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
CLS 214 Diagnostic Microbiology	3
CLS 250-254 CLT Clinical Practicum	16
CLS 420 Clinical Educational Practices	1
<b>CLS Electives</b>	<b>2</b>
<i>Choose from the following:</i>	
CLS 301 Advanced Clinical Hematology Coagulation (3 cr.)	
CLS 302 Advanced Clinical Chemistry (2 cr.)	
CLS 303 Advanced Immunohematology (2 cr.)	
CLS 304 Advanced Clinical Microbiology (2 cr.)	
CLS 391 Laboratory Experience (1-3 cr.)	
CLS 498 Directed Study (1-4 cr.)	
<b>CIS Concentration</b>	<b>28-30</b>
IS 120 Computer Concepts [V]	2
CIS 155 Software Development with Databases	4
CIS 220 Network Concepts	2
CIS 250 Systems Development I	4
<b>CIS Elective</b>	<b>2-4</b>
<i>Choose one course from the following:</i>	
CIS 230 Novell Operating Systems (2 cr.)	
CIS 234 Microsoft Network Operating Systems (2 cr.)	
CS 302 Unix System Administration (4 cr.)	

CIS 255 Systems Development II	4
CIS 355 Web Applications Programming	3
CIS 415 Systems Development Project	3
CIS 464 Database Management	3
CIS 440 Management Information Systems (3 cr.) or CIS 491 Internship in Computer Information Systems (1-4 cr.)	1-3

<b>Other Required Courses</b>	<b>29</b>
BI 104 Human Anatomy and Physiology [III]	4
CH 105 Chemical Principles (or higher) [III]	8
CS 120 Computer Science I [V]	4
CS 122 Computer Science II	4
ET 281 Computer System Servicing	3
MA 171 Probability and Statistics* [V]	4

\*Math placement scores may require MA 105 or equivalent to be taken prior to this course.

### Cytotechnology Major

This major prepares students with the basic science background needed to meet admission requirements of clinical programs approved by the ASC or NAACLS. Cytology is the study of the structure and the function of cells. Cytotechnologists prepare cellular samples for study under the microscope and assist in the diagnosis of disease by the examination of these samples. Cytotechnologists are trained clinical laboratory science professionals who work with pathologists to detect microscopic changes in body cells that may be important in the early diagnosis of cancer.

The first three years of the curriculum are at the university while the fourth year is completed through an accredited cytotechnology practicum. The university is affiliated with hospitals in Wisconsin and Michigan; however, students may apply to any accredited school in the United States. If students meet the hospital's standards and are accepted, they register for the cytotechnology practicum courses at NMU and pursue a 12-month program under the direction of the hospital.

<b>Total Credits Required for Degree</b>	<b>124</b>
<b>Liberal Studies</b>	<b>30-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Required Courses in Major</b>	<b>44</b>
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
CLS 250C Clinical Practice	2
CLS 420 Clinical Educational Practices	1
CLS 480 Cytology Orientation	1
CLS 481 Tissue Cytology I	8
CLS 482 Tissue Cytology II	8
CLS 483 Tissue Cytology III	8
CLS 484 Applied Clinical Practicum	5
CLS 485 Advanced Cytology Techniques	2

<b>Other Required Courses</b>	<b>41</b>
BI 111 Introductory Biology: Principles [III]	4
BI 201 Human Anatomy	3
BI 206 Human Genetics	3
BI 218 Cell and Molecular Biology	4
BI 313 Cell Biology	4
BI 426 Human Histology	4
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
CH 220 Introduction to Organic Chemistry	5
MA 171 Introduction to Probability and Statistics [V]	4

<b>Biology Elective</b>	<b>2-5</b>
<i>Choose from the following:</i>	
BI 202 Human Physiology (5 cr.)	
BI 405 Immunology (3 cr.)	
BI 414 Electron Microscopy (3 cr.)	
BI 416 Experimental Cytogenetics (2-3 cr.)	
BI 423 Parasitology (3 cr.)	

<b>Electives</b>	<b>8-11</b>
<i>Choose from the following:</i>	
Any mathematics course above 100 excluding MA 171	
Any Physics course 200 level or above	
CH 450 Introductory Biochemistry (4 cr.)	
HL 101 Medical Terminology (1 cr.)	
CIS 110 Principles of Computer Information Systems [V] or IS electives [V] (1-4 cr.)	
Any CLS course (4 cr.)	

### Diagnostic Genetics Major with Two Tracks

The program offers a cytogenetics or molecular biology track. These tracks require the same course work at NMU but differ in the senior practicum. Diagnostic genetics focuses on the identification of abnormalities of chromosomes or regions of DNA associated with pathology and disease. This field is growing rapidly and is driven in part by discoveries of genes associated with inherited disorders that are reported by the human genome project, and in part by advances in biotechnology. The small-group, high-tech laboratory environments at Northern prepare students to function in clinical, research and commercial work settings. Students participate in two clinical practicum experiences—one at the sophomore level and another at the senior level. The senior practicum is conducted at Mayo Clinic in Rochester, Minnesota.

<b>Total Credits Required for Degree</b>	<b>126</b>
<b>Liberal Studies</b>	<b>30-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Required Courses in Major</b>	<b>57</b>
CLS 100 Obtaining a Blood Specimen	1
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 204 Clinical Microbiology (2 cr.) <i>and</i>	5
CLS 214 Diagnostic Microbiology (3 cr.) <i>or</i>	
BI 203 Medical Microbiology (5 cr.) <i>or</i>	
BI 303 General Microbiology (5 cr.)	

<b>CLS Electives</b>	<b>3</b>
<i>Choose from the following:</i>	
CLS 200 Urine and Body Fluid Analysis (1 cr.)	
CLS 202 Clinical Chemistry (4 cr.)	
CLS 203 Immunohematology (3 cr.)	
CLS 213 Clinical Immunology and Serology (1 cr.)	
CLS 391 Laboratory Experience (1-3 cr.)	

<b>*CLS Practicum (5 weeks)</b>	<b>5</b>
<i>Choose 250T plus from the following to correspond with prerequisite courses chosen above: CLS 251, CLS 252, CLS 253, CLS 254, CLS 391</i>	

CLS 420 Clinical Education Practices	1
BI 218 Cell and Molecular Biology	4
BI 312 Genetics	4
BI 313 Cell Biology	4
BI 416 Cytogenetics	2
BI 418 Molecular Biology	4
CH 454 Biochemical Techniques	4

<b>CLS Senior Practicum (6 months)</b>	<b>16</b>
<i>Choose cytogenetics practicum or molecular biology practicum below.</i>	

<b>Cytogenetics Practicum</b>	
CLS 250G Clinical Practice	2
CLS 460 Specimen Processing and Culture	4
CLS 461 Microscopic Analysis	4
CLS 462 FISH Technology	3
CLS 463 CG Specialized Tech/Projects	3

<b>Molecular Biology Practicum</b>	
CLS 250G Clinical Practice	2
CLS 470 DNA Purification	2
CLS 471 Southern Blot Analysis	5
CLS 472 PCR Analysis	5
CLS 473 MB Specialized Tech/Projects	2

<b>Other Required Courses</b>	<b>33-35</b>
BI 111 Introductory Biology: Principles [III]	4
BI 104 Human Anatomy and Physiology [III] <i>or</i>	3-4
BI 201 Human Anatomy	
BI 404 Virology <i>or</i>	3-4
BI 419 Biology of Cancer	
BI 405 Immunology	3
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
CH 220 Introductory Organic Chemistry	5
CH 450 Introductory Biochemistry	4
MA 171 Introduction to Probability and Statistics [V]	4

<b>Diagnostic Genetics Electives</b>	<b>3-5</b>
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*\*Note: Students may substitute any clinical laboratory science practicum (above 200) in place of the CLS 2XX series.*

### Histotechnologist Major

This program prepares students with the basic science background needed to meet the requirements for admission to clinical programs approved by the ASC or NAACLS. Histology is the study of tissues. Histotechnologists perform all functions of the histotechnician plus they identify tissue structures, cell component and staining characteristics, relate these to physiologic functions, implement and evaluate new techniques and procedures, make quality control judgments and apply principles of management and education methodology when appropriate. The first three years of the curriculum are at the university, while the fourth year is completed through an accredited histotechnology practicum. The university is affiliated with hospitals in Wisconsin and Michigan; however, students may apply to any accredited school in the United States. If students meet the hospital's standards and are accepted, they register for the histotechnology practicum courses at NMU and pursue a twelve-month program under the direction of the hospital.

<b>Total Credits Required for Degree</b>	<b>124</b>
<b>Liberal Studies</b>	<b>30-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Required Courses in Major</b>	<b>42</b>
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
CLS 250H Clinical Practice	2
CLS 380 Histotechnique I	7
CLS 381 Histotechnique II	7
CLS 382 Histotechnique III	3
CLS 383 Histochemistry/Pathology	8
CLS 384 Advanced Histology	5
CLS 420 Clinical Educational Practices	1
<b>Other Required Courses</b>	<b>54</b>
BI 111 Introductory Biology: Principles [III]	4
BI 201 Human Anatomy	3
BI 202 Human Physiology	5
BI 206 Human Genetics	3
BI 218 Cell and Molecular Biology	4
BI 313 Cell Biology	4
BI 405 Immunology	3
BI 426 Human Histology	4
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
CH 220 Introductory Organic Chemistry	5
CH 450 Introductory Biochemistry	4
HL 101 Medical Terminology	1
MA 171 Introduction to Probability and Statistics [V]	4

### Science Technologist Major

This major prepares graduates to be premier laboratorians who are employable in a variety of laboratory settings (clinical, commercial, research, biotechnology, forensic). Students are exposed to a wide variety of methods, principles, instruments, technical skills and laboratory problems. The curriculum is built upon a firm foundation in clinical techniques, but students have options in course selection to pursue one of three areas: clinical certification, biotechnology or forensics. Students who have first completed an associate degree program in clinical lab technician, histotechnician or science technician will find that much of their course work may be applied to the science technologist degree.

<b>Total Credits Required for Degree</b>	<b>128</b>
<b>Liberal Studies</b>	<b>30-40</b>
<b>Health Promotion</b>	<b>2</b>
<b>Required Courses in Major</b>	<b>39</b>
CLS 302 Advanced Clinical Chemistry	2
CLS 391 Laboratory Experience	1-4
CLS 420 Clinical Educational Practices	1
<b>CLS Electives</b>	<b>15-19</b>
<i>Choose from the following:</i>	
CLS 100 Obtaining a Blood Specimen (1 cr.)	
CLS 109 Introduction to Diagnostic Sciences (1 cr.)	
CLS 190 Microscopy and Laboratory Techniques (1 cr.)	
CLS 200 Urine and Body Fluid Analysis (1 cr.)	
CLS 201 Clinical Hematology/Coagulation (3 cr.)	
CLS 202 Clinical Chemistry (4 cr.)	
CLS 203 Immunohematology (3 cr.)	
CLS 204 Clinical Microbiology (2 cr.)	
CLS 213 Clinical Immunology and Serology (1 cr.)	
CLS 214 Diagnostic Microbiology (3 cr.)	
CLS 301 Advanced Hematology/Coagulation (3 cr.)	
CLS 303 Advanced Immunohematology (2 cr.)	
CLS 304 Advanced Clinical Microbiology (2 cr.)	
<b>Clinical Laboratory Technology Emphasis*</b>	<b>16</b>
<i>Must have taken the following courses: CLS 100, CLS 109, CLS 190, CLS 200, CLS 201, CLS 202, CLS 203, CLS 204, CLS 213 and CLS 214 or equivalent.</i>	
CLS 250T Clinical Practice	2
CLS 251 Clinical Hematology Practicum	3
CLS 252 Clinical Chemistry Practicum	4
CLS 253 Blood Banking Practicum	3
CLS 254 Clinical Microbiology Practicum	4
<b>DNA/Forensic Emphasis</b>	<b>16</b>
BI 418 Molecular Biology	4
CJ 110 Introduction to Criminal Justice	4
Criminal Justice Electives	8
<i>Choose from the following</i>	
CJ 213 The Judicial Function (4 cr.)	
CJ 214 The Investigative Process I (4 cr.)	
CJ 290 Methods of Inquiry (4 cr.)	
CJ 414 The Investigative Process II (4 cr.)	

<b>Biotechnology Emphasis</b>	<b>16</b>
BI 313 Cell Biology	4
BI 418 Molecular Biology	4
CH 450 Introductory Biochemistry	4
CH 454 Biochemical Techniques	4

<b>Other Required Courses</b>	<b>44-45</b>
BI 111 Introduction to Biology: Principles [III]	4
BI 104 Human Anatomy and Physiology [III]	4
BI 206 Human Genetics or BI 312 Genetics	3-4
BI 218 Cell and Molecular Biology	4
CH 111 General Chemistry I [III]	5
CH 112 General Chemistry II [III]	5
CH 220 Introductory Organic Chemistry	5
MA 171 Introduction to Probability and Statistics [V]	4
PH 201 College Physics I [III]	5
PH 202 College Physics II [III]	5

<b>Science Technologist Electives**</b>	<b>18-19</b>
<i>Recommend that electives be chosen from the following courses:</i>	
BI 303 General Microbiology (3 cr.)	
BI 404 Virology (3 cr.)	
BI 405 Immunology (3 cr.)	
BI 414 Electron Microscopy (4 cr.)	
BI 416 Experimental Cytogenetics (3 cr.)	
BI 426 Human Histology (3 cr.)	
MGT 240 Organizational Behavior and Management (3 cr.)	
CIS 110 Principles of Computer Information Systems (4 cr.) [V]	
CH 241 Chemical Equilibrium (3 cr.)	
CH 242 Quantitative Analysis (2 cr.)	
CLS Electives	

*\*Any clinical laboratory technology certification at the associate level or above is acceptable.*

*\*\*Other electives may be chosen depending on student interest. Students interested in graduate education should choose additional courses in organic chemistry, physical chemistry, calculus and cell biology. Students may also consider a major in biology/physiology or biochemistry if graduate education is the goal.*

## ASSOCIATE DEGREE PROGRAMS

### Clinical Laboratory Technician *Associate of Applied Science*

This program develops proficiency in the performance of a variety of tests as well as an understanding of the interrelationships of laboratory data and physiological processes. Clinical laboratory technicians perform routine laboratory tests under supervision to provide diagnostic data in clinical and biomedical industries. The first three semesters of the program consist of liberal arts, science and clinical laboratory science courses taken on campus. During the last six months of the second year, students are placed in an affiliated hospital to complete a clinical practicum.

**Total Credits Required for Degree** **64**

<b>Liberal Studies</b>	<b>12</b>
EN 111 College Composition I	4
EN 211 College Composition II	4
Humanities or Social Science Elective	4

<b>Health Promotion</b>	<b>1</b>
HP 200 Physical Well Being	1

<b>Required Courses in Major</b>	<b>36</b>
CLS 100 Obtaining a Blood Specimen	1
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 202 Clinical Chemistry	4
CLS 203 Immunohematology	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
CLS 214 Diagnostic Microbiology	3
CLS 250T Clinical Practice	2
CLS 251 Clinical Hematology Practicum	3
CLS 252 Clinical Chemistry Practicum	4
CLS 253 Blood Banking Practicum	3
CLS 254 Clinical Microbiology Practicum	4

<b>Other Required Courses</b>	<b>12</b>
BI 104 Human Anatomy and Physiology	4
CH 105 Chemical Principles (or higher)	8

<b>General Elective</b>	<b>3</b>
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*Students who score below a predictive "C" on Northern Michigan University's mathematics placement test for MA 104 are required to take MA 100. Students who score a "C" or higher are exempt from the mathematics requirement.*

## Histotechnician

### *Associate of Applied Science*

This major provides students with a basic science background needed to meet the requirements for admission to a clinical program accredited by The National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). Histotechnicians prepare sections of body tissue for examination by a pathologist to diagnose body dysfunction and malignancy. The specimens may be used for diagnostic, research or teaching purposes.

<b>Total Credits Required for Degree</b>	<b>71-89</b>
<b>Liberal Studies</b>	<b>12</b>
EN 111 College Composition I	4
EN 211 College Composition II	4
Humanities or Social Science Elective	4
<b>Health Promotion</b>	<b>1</b>
HP 200 Physical Well Being	1
<b>Required Courses in Major</b>	<b>23-41</b>
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
<b>Practicum</b>	<b>14-32</b>
<i>Choose from the following:</i>	
<b>6-month practicum or</b>	
CLS 380 Histotechnique I	7
CLS 381 Histotechnique II	7
<b>12-month practicum:</b>	
CLS 250H Clinical Practice	2
CLS 380 Histotechnique I	7
CLS 381 Histotechnique II	7
CLS 382 Histotechnique III	3
CLS 383 Histochemistry/Pathology	8
CLS 384 Advanced Histology	5
<b>Other Required Courses</b>	<b>35</b>
MA 104 College Algebra with Applications in the Sciences and Technologies (or above)	4
BI 111 Introductory Biology: Principles	4
BI 201 Human Anatomy	3
BI 202 Human Physiology	5
BI 206 Human Genetics	3
CH 111 General Chemistry I	5
CH 112 General Chemistry II	5
CH 220 Introduction to Organic Chemistry	5
HL 101 Medical Terminology	1

## Science Technician

### *Associate of Applied Science*

This program prepares graduates to work in a variety of laboratory settings (biomedical, commercial, etc.). Students are provided with a basic foundation in clinical techniques complemented with science, math and computer courses. The science technician degree may "ladder" into the science technologist degree with no loss of credit.

<b>Total Credits Required for Degree</b>	<b>65</b>
<b>Liberal Studies</b>	<b>12</b>
EN 111 College Composition I	4
EN 211 College Composition II	4
Humanities or Social Science Elective	4
<b>Health Promotion</b>	<b>1</b>
HP 200 Physical Well Being	1
<b>Required Courses in Major</b>	<b>23</b>
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 200 Urine and Body Fluid Analysis	1
CLS 201 Clinical Hematology/Coagulation	3
CLS 202 Clinical Chemistry	4
CLS 203 Immunohematology	3
CLS 204 Clinical Microbiology	2
CLS 213 Clinical Immunology and Serology	1
CLS 214 Diagnostic Microbiology	3
BI 104 Human Anatomy and Physiology	4
<b>Other Required Courses</b>	<b>29</b>
BI 111 Introductory Biology: Principles	4
BI 218 Cell and Molecular Biology	4
MA 104 College Algebra with Applications in the Sciences and Technologies (or above)	4
CH Electives (100 level or above)	8
PH Electives (200 level or above)	5
CIS 110 Principles of Computer Information Systems or IS Electives	4



## CERTIFICATE PROGRAMS

### Clinical Assistant Certificate

Clinical assistants are members of the health care delivery team. They perform a variety of duties under the supervision of a laboratory scientist, nurse or other medical personnel such as specimen procurement and sample processing, basic laboratory testing, patient processing, basic technical nursing procedures and secretarial work. This one-year program includes an introduction to fundamental laboratory, office, and nursing skills. During the second semester, students train in clinical sites within the Marquette area. The first phase of the program allows students to gain proficiency in phlebotomy (obtaining a blood specimen) and become eligible for phlebotomy certification. The second phase expands into the multi-skilled areas so graduates are eligible for employment in a variety of health care settings.

<b>Total Credits Required for Certificate</b>	<b>33</b>
<b>Liberal Studies</b>	<b>4</b>
EN 111 College Composition I	4
<b>Health Promotion</b>	<b>1</b>
HP 200 Physical Well Being	1
<b>Required Courses in Major</b>	<b>18</b>
CLS 100 Obtaining a Blood Specimen	1
CLS 109 Introduction to Diagnostic Sciences	1
CLS 190 Microscopy and Laboratory Techniques	1
CLS 150 Phlebotomy Practicum	4
CLS 250A Clinical Practice	2
AH 125 Clinical Assistant Skills	3
OIS 101 Keyboarding for Info. Processing	1
OIS 103 Beginning Formatting/Typing	1
OIS 183 Office Procedures	4
<b>Other Required Courses</b>	<b>10</b>
BI 104 Human Anatomy and Physiology	4
HL 242 Emergency Health Care	2
MA 090 Beginning Algebra (if needed)*	4

**Elective (if MA 090 not needed)**

*\*If math placement test indicates placement into a higher level math, math is not needed.*

### Surgical Technology Certificate *Surgical Technology*

This program prepares graduates to assist the surgeon and other members of the operating room team. Duties may include such tasks as setting up sterile trays and equipment for procedures; scrubbing for procedures with the surgeon; draping patients, passing instruments, and holding retractors; sterilizing instruments and supplies; and maintaining stock inventory. The program consists of theory and practical experience in the operating room setting. Courses must be taken sequentially. Graduates are qualified to take the Liaison Council on Certification for Surgical Technologist (LCC-ST) national examinations.

**Total Credits Required for Certificate** **39**

**Required Prerequisite Courses**

<b>Fall Semester</b>	<b>14</b>
BI 104 Human Anatomy and Physiology	4
EN 111 College Composition I	4
ST 104 Introduction to Surgical Technology	1
HP 200 Physical Well Being	1
OIS 171 Medical Terminology	4

**Upon receiving notice of acceptance into the surgical technology program the following sequence of classes will be followed:**

<b>Winter Semester</b>	<b>13</b>
ST 111 Basic Surgical Concepts/Techniques	5
ST 112 Surgical Technology I	2
ST 113 Surgical Technology I Practicum	6
<b>Summer Semester</b>	<b>12</b>
ST 114 Surgical Technology II	2
ST 115 Surgical Technology II Practicum	10

## MINOR PROGRAM

### Clinical Laboratory Techniques Minor

**Total Credits Required for Minor** **20**

*20 credits of CLS courses. No more than 4 credits in Directed Studies or CLS 391 may be used.*