Sentara®

School of Medical Laboratory Science

Curriculum Guide

Student Handbook

School/Student Catalog

Class: June to December 2026

SRMH School of Medical Laboratory Science

2010 Health Campus Drive
Harrisonburg, VA. 22801

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Sentara RMH School of Medical Laboratory Science
June 2026 to June 2027

The Sentara RMH School of Medical Laboratory Science is certified to operate by the State Council of Higher Education for Virginia (SCHEV).

The Sentara RMH School of Medical Laboratory Science is accredited by NAACLS.
(773) 714-8880, www.naacls.org.
NAACLS
5600 N. River Road
Suite 720
Rosemont, IL. 60018-5119

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Section 1

Sentara RMH School of Medical Laboratory Science

(Reviewed 4/22/2026)

Chief Administrator/Officer of School

Jamin Engle

Sentara RMH Medical Center VP, Hospital Operations
and
Interim CEO

Duties and responsibilities of the officer above is ultimate administration of Sentara RMH School of Medical Laboratory Science.

Sentara RMH School of Medical Laboratory Science

Plan for When Applied Experience Cannot be Guaranteed

(Reviewed 4/22/2026)

Selection of students will be limited annually to the number of slots available on clinical rotation.

Because of the large number of hospitals in the Sentara System, there should always be rotation slots to accommodate students for rotation should a disaster occur in one of the hospitals.

With regard to the didactic portion of the program, if the Sentara RMH School of Medical Laboratory Science would close, the lectures on file along with Power Points for the entire curriculum would be available to another Sentara Facility and their Lab departments. These certified medical laboratory scientists could complete the didactic portion for the remaining months until the current class had finished the program.

The following is a list of all the hospitals in the Sentara Healthcare System:

Sentara Albemarle Medical Center- Elizabeth City, NC
Sentara CarePlex Hospital- Hampton, VA
Sentara Halifax Regional Hospital- South Boston, VA
Sentara Leigh Hospital- Norfolk, VA
Sentara Martha Jefferson Hospital- Charlottesville, VA
Sentara Norfolk General Hospital- Norfolk, VA
Sentara Northern Virginia Medical Center- Woodbridge, VA
Sentara Obici Hospital- Suffolk, VA
Sentara Princess Anne Hospital- Virginia Beach, VA
Sentara RMH Medical Center- Harrisonburg, VA
Sentara Virginia Beach General Hospital- Virginia Beach, VA
Sentara Williamsburg Regional Medical Center- Williamsburg, VA

Further details of the didactic and rotation completion would be formulated if a closing of Sentara RMH School of Medical Laboratory Science should occur.

There is an affiliation agreement between Sentara RMH School of Medical Laboratory Science and all of the Sentara Hospitals.

Sentara RMH School of Histotechnology and Medical Laboratory Science

Record Retention in Event of Schools' Closure or Revocation of Certification

(Reviewed 4/22/2026)

In the event of schools closure or revocation of certification, the schools shall make provisions for transferring all official records of students to the council office, or secure location that will maintain the records permanently, notify all students of this location and how they may obtain official copies. The records transferred to the council office, or other depository, shall include the academic records of each student, which should include:

1. Academic transcripts showing the basis of admissions, transfer credits, courses, credit, grades, graduation authorization, and student name changes for each student;
2. As no financial aid is offered to the students, there will be no record of transcripts of financial aid;
3. Foreign transcript review for students who completed degrees outside of the US;
4. Veterans Administration records for veterans;
5. Copies of certificates awarded;
6. One set of course descriptions for all courses offered by the school;
7. Copy of NAACLS accreditation during the years covered by transcripts.

The schools shall notify all enrolled students of the pending closure immediately, describing their financial obligations as well as their right s to a refund or adjustment, and provisions made for assistance toward completion of their academic programs, whether by the institution that is closing, or by contract with another institution or organization to teach out the educational programs.

This policy is in addition to the schools policy on "if applied experience cannot be guaranteed."

Section 2

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia
(Reviewed 4/22/2026)

Sentara RMH Medical Center, founded in 1912, is located in Harrisonburg, Va. Sentara RMH is a not-for-profit, community-based regional healthcare facility licensed for 266 beds and fully accredited by DNV. Sentara Healthcare is a not-for-profit healthcare organization serving

Virginia and northeastern North Carolina. It is based in Norfolk, Virginia and offers services in 12 acute care hospitals with more than 300 sites of care all throughout Virginia and northeastern North Carolina and beyond. The Sentara RMH MLS program was established in 1968 as the Rockingham Memorial Hospital School of Medical Technology to provide RMH with a well-trained laboratory staff. The online program was added in 2022 to provide employees of Sentara a flexible option to complete MLS training. In 2025 the online program was opened to students who are not Sentara employees.

The program runs for one calendar year and includes six months of lecture and student lab followed by six months of rotation through a hospital laboratory. Clinical rotations are provided by the Clinical Laboratories at the following Sentara hospitals; Sentara RMH Medical Center, Sentara Martha Jefferson Hospital, Sentara Northern Virginia Medical Center, Sentara Halifax Medical Center and Sentara Norfolk General Hospital.

During the didactic portion of the program lectures and student labs cover the theory and applications of laboratory medicine in Hematology, Clinical Chemistry, Immunohematology, Microbiology, and Laboratory Education & Management. Students choose the hospital for their clinical rotation during the application process on a first come-first serve basis. During the clinical rotation, students learn by working alongside the laboratory professionals in the department.

Entering students will be required to have a bachelor's degree with a minimum of 16 credits in biology and 16 credits chemistry prior to beginning the program or be guaranteed a degree from their college or university upon completion of the program. A certificate will be awarded at the completion of the school.

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

MISSION STATEMENT

(Reviewed 4/22/2026)

It is the mission of the Sentara RMH School of Medical Laboratory Science to graduate beginning medical laboratory scientists with the skills, knowledge, motivation, and insight to excel in the practice of laboratory medicine, and to pass national certification examinations. These graduates will be motivated to continue their education, and to become our future educators, leaders, innovators and managers in the laboratory. The school will remain on the cutting edge of laboratory education providing the students with the curriculum that is current, safety conscious, and responsive to the dynamic health care environment.

The school's purpose includes an emphasis of 98% on instruction, 2% on research in the form of lectures during the education course, and 0% on public service.

Sentara RMH School of Medical Laboratory Science

Program Goals

(Reviewed 4/22/2026)

- To provide 3+1 and 4+1 students in medical laboratory science in a safe environment with the theoretical background and practical laboratory skills required to work in any specialty of the medical laboratory.
- To instill in students professional integrity and pride.
- To educate students with a thorough knowledge of the clinical correlation of laboratory test results and disease.
- To provide sufficient background material in medicine and physiology for an intelligent understanding of diagnostic work.
- To instill in students an understanding of the importance of their work as scientists on a medical team whose sole purpose is the patient.
- To maintain the standards of the profession of medical laboratory science.
- To prepare students to successfully pass the Board of Certification exam.
- To graduate laboratory scientists with a strong education and laboratory management background for a future role in education and management leadership.

Section 3

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Faculty

Cyndee Lowe, M.A. MLS(ASCP)[CM]
Program Director, Sentara RMH Schools of Medical Laboratory Science,
Histotechnology and Phlebotomy

Abigail Blosser, B.S., MLS(ASCP)[CM]
Education Program Coordinator, Sentara RMH School of Medical Laboratory Science

Emileigh Conley, B.S., MLS(ASCP)[CM]
Instructor, Sentara RMH School Medical Laboratory Science and School of Phlebotomy

Becca Thompson, B.S., MLS(ASCP)[CM]
Instructor, Sentara RMH School Medial Laboratory Science,
Recruiter RMH Laboratory Schools

Sentara Laboratory Services Education Department

Jessica Linhardt, B.S., MLS(ASCP), M.B.A
Clinical Specialist for Education

Alison Tirado, MLS(ASCP)
Senior Scientist for Education

Tiffany Outlaw, MLS(ASCP)
Senior Scientist of Education

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Faculty Selection Policy

(Revised 4/22/2026)



The selection of faculty for the Sentara RMH School of Medical Laboratory Science is based on the following criteria:

1. Interest in education
2. Teaching ability
3. Two years of medical technology/clinical laboratory scientist experience
4. Certification - MT(ASCP), preferred MLS(ASCP)^{CM}, education, and continuing education

Sentara seeks to select qualified applicants without regard to race, color, religion, age, sex, marital status, gender identity and expression, sexual orientation, pregnancy, childbirth or related medical conditions, including lactation, military status, genetic information, national origin, disability, or any other legally protected status, providing the applicant is qualified to perform the essential functions of the job with or without reasonable accommodation.

It is recommended that faculty have a minimum of a B.S. degree (Master's Degree preferred) and national certification MT (ASCP), with MLS (ASCP)^{CM} preferred.

Section 4

Sentara RMH School of Medical Laboratory Science

Outcome Measures

(Reviewed 4/22/2026)

The school does the following to evaluate and improve the program success to be consistent with the mission of the school:

1. Monitor and report pass rate on ASCP Certification Exam.

2. Monitor placement rates of graduates.

3. Monitor graduation and attrition rates.

4. Request evaluations of the program from :
   - Students
   - Graduates
   - Faculty
   - Employers
   - Advisory Committee

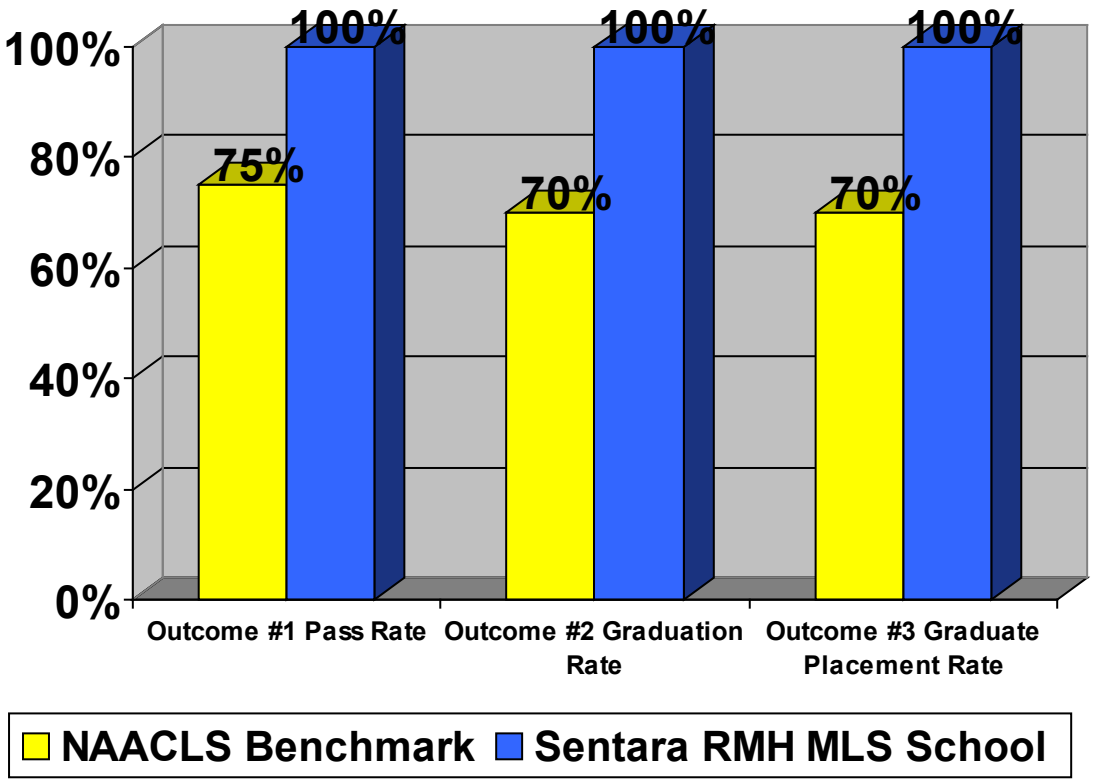
School of Medical Laboratory Science

Three Year Summary of Program Outcome Measures

The following percentages are calculated on results from Jan. 2022 through Dec. 2025	
Certification Pass Rate	100%
Graduation Rate	100%
Placement Rate	100%

(Updated 12/17/2025)

Comparison of Outcome Measures with NAACLS Benchmarks
Sentara RMH School of Medical Laboratory Science
January 2022-December 2025



Section 5

Sentara RMH School of Medical Laboratory Science

Academic Calendar

(Reviewed 4/22/2026

The academic calendar includes all the time from the beginning of class in January or June to the graduation date in December or June respectfully. This includes approximately 12 months with 6 months of didactic and 6 months of clinical/rotation per calendar year.

June 2026

May '26

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

July '26

S	M	T	W	T	S
			1	2	4
5	6	7	8	9	11
12	13	14	15	16	18
19	20	21	22	23	25
26	27	28	29	30	

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15 MLS & HTL Program Orientation	16 9:00 Immunology 1 10:30 Orientation 1 1:30 Chemistry 1	17 9:00 Micro 1 1:30 Hematology 1	18 9:00 Immunology 2 10:30 Orientation 2 1:30 Chemistry 2	19 9:00 Hematology 2 1:30 Micro 2	20
21	22 9:00 Micro 3 10:30 Hematology 3 1:30 Orientation Final	23 9:00 Immunology 3 1:30 Chemistry 3	24 9:00 Micro 4 10:30 Hematology 4 1:30 Hematology Exam 1	25 9:00 Immunology 4 10:30 Hematology 5 1:30 Chemistry 4	26 9:00 Micro 5 10:30 Chemistry 5 1:30 Immunology Exam 1	27
28	29 9:00 Micro 6 10:30 Hematology 6 1:30 Micro 7	30 9:00 Micro 8/Immuno 5 10:30 Chemistry 6 1:30 Micro 8/Immuno 6	1	2	3	4
5	6					

July 2026

June '26

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

August '26

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28 Open Immunology E2 7/2 - 7/10	29	30	1 9:00 Immunology 7 10:30 Immunology 8 1:30 Hematology 7	2 9:00 Chemistry 7 1:30 Immunology E2	3 No Class	4
5 Open Hematology E2 7/6/26 - 7/10/26 Open Chemistry E1 7/3/26 - 7/9/26	6 No Class 1:30 Hematology Exam 2	7 No Class	8 9:00 Micro 9 1:30 Micro Review	9 9:00 Micro 10	10 9:00 Immunology 9 1:30 Micro Exam 1	11
12	13 9:00 Micro 11 1:30 Hematology 8	14 9:00 Micro Lab 1:30 Immunology 10	15 9:00 Micro Lab 1:30 Hematology 9	16 9:00 Immunology 11 1:30 Chemistry 8	17 9:00 Micro 12 1:30 Hematology 10	18
19	20 9:00 Micro 13 1:30 Hematology 11	21 9:00 Chemistry 9 1:30 Immunology Exam 3	22 9:00 Micro Lab 1:30 Hematology 12	23 9:00 Immunology 12 1:30 Chemistry 10	24 9:00 Micro 14 1:30 Hematology 13	25
26	27 9:00 Micro 15 10:30 Hematology 14 Rev 1:30 Micro Exam 2	28 9:00 Chemistry 11 1:30 Immunology 13	29 9:00 Micro 16 1:30 Chemistry 12	30 9:00 Micro 17 1:30 Hematology Exam 3	31 9:00 Immunology 14 1:30 Hematology 15	1
2	3					

August 2026

July '26

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September '26

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
26	27	28	29	30	31	1
2	3 9:00 Micro Lab 1:30 Hematology 16	4 9:00 Micro Lab 1:30 Chemistry Exam 2	5 9:00 Micro Lab 1:30 Hematology 17 Rev	6 9:00 Immunology Review 1:30 Chemistry 13	7 9:00 Micro Exam 3 1:30 Hematology Exam 4	8
9	10 9:00 Micro 18 1:30Immunology Final	11 9:00 Chemistry 14 1:30 Hematology 18	12 9:00 Micro 19 1:30 Hematology 19	13 9:00 Blood Bank 1 1:30 Chemistry 15	14 9:00 Micro 20 1:30 Hematology 20	15
16	17 9:00 Micro Review 1:30 Hematology 21	18 9:00 Blood Bank 2 1:30 Chemisty 16	19 9:00 Hematology 22 Rev 1:30 Micro Exam 4	20 9:00 Blood Bank 3 1:30 Chemistry 17	21 9:00 Micro 21 1:30 Hematology Exam 5	22
23	24 9:00 Micro 22 1:30 Hematology 23	25 9:00 Blood Bank Lab 1:30 Chemistry Exam 3	26 9:00 Micro 23 1:30 Hematology 24	27 9:00 Blood Bank 5 1:30 Chemistry 18	28 9:00 Micro 24 1:30 Hematology 25	29
30	31 9:00 Chemistry 19 1:30 Micro Exam 5	Notes				

September 2026

August '26

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

October '26

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	1 9:00 Blood Bank 5 1:30 Hematology Exam 6	2 9:00 Micro 25 1:30 Chemistry 20	3 9:00 Micro 26 1:30 Hematology 26	4 9:00 Micro 27 1:30 Hematology 27	5
6	7 LABOR DAY NO CLASS	8 9:00 Coag 1 10:30 Chemistry 21 1:30 Blood Bank Exam 1	9 9:00 Micro 28 1:30 Hematology 28 Rev	10 9:00 Blood Bank 6 10:30 Coag 2 1:30 Chemistry Exam 4	11 9:00 Micro 29 10:30 Hematology 29 Rev 1:30 Micro Exam 6	12
13	14 9:00 Micro 30 1:30 Hematology Final	15 9:00 Blood Bank Lab 10:30 Coag 3 1:30 Chemistry 22	16 9:00 Micro 31 1:30 Urinalysis 1	17 9:00 Blood Bank 7 10:30 Coag 4 1:30 Chemistry 23	18 9:00 Urinalysis 2 1:30 Micro Exam 7	19
20	21 9:00 Micro 32 - Vir. 1 1:30 Urinalysis 3	22 9:00 Blood Bank 8 10:30 Coag 5 1:30 Chemistry 24	23 9:00 Micro 33 - Vir. 2 1:30 Urinalysis 4	24 9:00 Coag 6 10:30 Chemistry 25 Rev 1:30 Blood Bank Exam 2	25 9:00 Micro 34 - Vir. 3 1:30 Urinalysis Exam 1	26
27	28 9:00 Micro 35- Vir. 4 10:30 Coag 5 1:30 Urinalysis 5	29 9:00 Blood Bank 9 10:30 Coag 7 1:30 Chemistry Exam 5	30 9:00 Micro 36- Vir 5 1:30 Urinalysis 6	1	2	3
4	5	Notes				

October 2026





Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	1 9:00 Blood Bank Lab 1:30 Chemistry 26	2 9:00 Coag 8 10:30 Micro Exam 8 (Vir) 1:30 Urinalysis Exam 2	3
4	5 9:00 Micro 37/Parasit. 1 1:30 Urinalysis 7	6 9:00 Blood Bank 10 10:30 Coag 9 1:30 Chemistry 27	7 9:00 Micro 38/Parasit. 2 1:30 Urinalysis 8	8 9:00 Blood Bank Panels 10:30 Chemistry 28 1:30 Coag Final	9 9:00 Micro 39/Parasit. 3 1:30 Urinalysis Exam 3	10
11	12 9:00 Micro 40/Parasit. 4 1:30 Urinalysis 9	13 9:00 Blood Bank 11 1:30 Chemistry 29	14 9:00 Micro 41/Parasit. 5 1:30 Urinalysis 10	15 9:00 Blood Bank 12 10:30 Blood Bank 13 1:30 Chemistry Final	16 9:00 Micro 42/Parasit. 6 10:30 Phlebotomy 1 1:30 Urinalysis 11	17
18	19 9:00 Micro 43/Parasit. 7 and Review 1:30 Urinalysis Final	20 9:00 Micro 44/Myco 1 10:30 Phlebotomy 2 1:30 Blood Bank Exam 3	21 9:00 Micro 45/Myco. 2 10:30 Phlebotomy 3 1:30 Micro Exam 9 (Para)	22 9:00 Phlebotomy 4 1:30 Blood Bank 14	23 9:00 Blood Bank 15 1:30 Education 1	24
25	26 9:00 Blood Bank 16 10:30 Phlebotomy 5 1:30 Micro 46/Myco. 3	27 9:00 Micro 47/Myco. 4 1:30 Education 2	28 9:00 Blood Bank 17 1:30 Phlebotomy Final	29 9:00 Micro Exam 10 (Myco)	30	31
1	2	Notes				

November 2026

October '26

M	T	W	T	F	S
			1	2	3
5	6	7	8	9	10
12	13	14	15	16	17
19	20	21	22	23	24
26	27	28	29	30	31

December '26

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 9:00 PBT Practice & WPOC Lab 1:30 Education 3	3 9:00 Micro 48/ Infections by Site 1 1:30 Blood Bank 18	4 9:00 Micro 49/ Infections by Site 2 1:30 Education Final	5 9:00 Micro 50/ Infections by Site 3 1:30 Blood Bank 19	6 9:00 Micro 51/ Infections by Site 4 1:30 Blood Bank Exam 4	7
8	9 9:00 Micro 52/QC 1:30 Management 1	10 9:00 Blood Bank 20 1:30 Management 2	11 9:00 Management 3 1:30 Micro Exam 11 (Infections by Site/QC)	12 9:00 Blood Bank 21 1:30 Micro Case Studies	13 9:00 Blood Bank Review 1:30 Management Exam	14
15	16 9:00 Micro Review 1:30 Management 4	17 9:00 Blood Bank Review 1:30 Management 5	18 9:00 Micro Review 1:30 Management 6	19 9:00 Management 7 1:30 Blood Bank Final	20 9:00 Micro Review 1:30 Management Final	21
22	23 9:00 Micro Final	24 No Class	25 No Class	26 Thanksgiving	27 No Class	28
29	30 Rotation 1	1	2	3	4	5
6	7	Notes				

December 2026

November '26

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

January '27

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	1 Rotation 1	2 Rotation 1	3 Rotation 1	4 Rotation 1	5
6	7 Rotation 2	8 Rotation 2	9 Rotation 2	10 Rotation 2	11 Rotation 2	12
13	14 Rotation 3	15 Rotation 3	16 Rotation 3	17 Rotation 3	18 Rotation 3	19
20	21 Holiday Break	22 Holiday Break	23 Holiday Break	24 Holiday Break	25 Christmas Day	26
27	28 Holiday Break	29 Holiday Break	30 Holiday Break	31 New Years Eve	1	2
3	4	Notes				

January 2027

December '26

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February '27

S	M	T	W	T	S
	1	2	3	4	6
7	8	9	10	11	13
14	15	16	17	18	20
21	22	23	24	25	27
28					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	31	1 New Year's Day	2
3	4 Rotation 4	5 Rotation 4	6 Rotation 4	7 Rotation 4	8 Rotation 4	9
10	11 Rotation 5	12 Rotation 5	13 Rotation 5	14 Rotation 5	15 Rotation 5	16
17	18 Rotation 6	19 Rotation 6	20 Rotation 6	21 Rotation 6	22 Rotation 6	23
24	25 Rotation 7	26 Rotation 7	27 Rotation 7	28 Rotation 7	29 Rotation 7	30
31	1	Notes				

February 2027

January '27

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

March '27

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
31	1 Rotation 8	2 Rotation 8	3 Rotation 8	4 Rotation 8	5 Rotation 8	6
7	8 Rotation 9	9 Rotation 9	10 Rotation 9	11 Rotation 9	12 Rotation 9	13
14	15 Rotation 10	16 Rotation 10	17 Rotation 10	18 Rotation 10	19 Rotation 10	20
21	22 Rotation 11	23 Rotation 11	24 Rotation 11	25 Rotation 11	26 Rotation 11	27
28	1 Rotation 12	2 Rotation 12	3 Rotation 12	4 Rotation 12	5 Rotation 12	6
7	8	Notes				

March 2027

February '27

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

April '27

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28	1 Rotation 13	2 Rotation 13	3 Rotation 13	4 Rotation 13	5 Rotation 13	6
7	8 Rotation 14	9 Rotation 14	10 Rotation 14	11 Rotation 14	12 Rotation 14	13
14	15 Rotation 15	16 Rotation 15	17 Rotation 15	18 Rotation 15	19 Rotation 15	20
21	22 Rotation 16	23 Rotation 16	24 Rotation 16	25 Rotation 16	26 Rotation 16	27
28	29 Rotation 17	30 Rotation 17	31 Rotation 17	1	2	3
4	5	Notes				

April 2027

March '27

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

May '27

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28	29	30	31	1 Rotation 17	2 Rotation 17	3
4	5 Rotation 18	6 Rotation 18	7 Rotation 18	8 Rotation 18	9 Rotation 18	10
11	12 Rotation 19	13 Rotation 19	14 Rotation 19	15 Rotation 19	16 Rotation 19	17
18	19 Rotation 20	20 Rotation 20	21 Rotation 20	22 Rotation 20	23 Rotation 20	24
25	26 Rotation 21	27 Rotation 21	28 Rotation 21	29 Rotation 21	30 Rotation 21	1
2	3	Notes				

May 2027

April '27

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

June '27

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
25	26	27	28	29	30	1
2	3 Rotation 22	4 Rotation 22	5 Rotation 22	6 Rotation 22	7 Rotation 22	8
9	10 Rotation 23	11 Rotation 23	12 Rotation 23	13 Rotation 23	14 Rotation 23	15
16	17 Rotation 24	18 Rotation 24	19 Rotation 24	20 Rotation 24	21 Rotation 24	22
23	24 Rotation 24	25 Rotation 24	26 Rotation 24	27 Rotation 24	28 Rotation 24	29
30	31 Memorial Day	Notes				

June 2027

May '27

M	T	W	T	F	S
					1
3	4	5	6	7	8
10	11	12	13	14	15
17	18	19	20	21	22
24	25	26	27	28	29
31					

July '27

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	1	2	3	4 Rotation Exam	5
6	7 Comprehensive Exam	8	9 Graduation	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	Notes				

Section 6

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Orientation Materials Checklist

(Revised 12/20/2024)

Name: Date:

- ☐ Copy of License
- ☐ Copy of Health Insurance
- ☐ Department Orientation
- ☐ Enrollment Agreement
- ☐ Essential Functions
- ☐ Honor Code
- ☐ Health and Safety Policy
- ☐ Confirmation of Knowledge
- ☐ Non-Patient Photo and Video Release
- ☐ Statement of Responsibility & Confidentiality
- ☐ Online Orientation Training

Sentara RMH School of Medical Laboratory Science
2010 Health Campus Drive
Harrisonburg, VA 28801
(Phone) 540-564-7232
(Fax) 540-437-0517
(Web Site) www.sentara.com/schoolofmls

STUDENT ENROLLMENT AGREEMENT

STUDENT INFORMATION

STUDENT NAME: _____

ADDRESS: _____

CITY/STATE/ZIP: _____

TELEPHONE #'S: H: _____C:_____W:_____

E-MAIL:_____

EMERGENCY CONTACT: _____

RELATIONSHIP: _____TELEPHONE #:_____

PROGRAM INFORMATION

EDUCATIONAL PROGRAM/COURSE: _____

PROGRAM START DATE: _____ANTICIPATED END DATE: _____

FULL-TIME: ☐ PART-TIME: ☐ DAY: ☐ EVENING: ☐
DAYS/EVENINGS CLASS MEETS: (CIRCLE) M T W TH F Sat Sun

TIME OF DAY/EVENING CLASS BEGINS: _____ TIME OF DAY/EVENING CLASS ENDS: _____

NUMBER OF WEEKS: _____ TOTAL CLOCK HOURS_____

UPON SUCCESSFUL COMPLETION OF THE PROGRAM, THE STUDENT WILL BE AWARDED A CERTIFICATE IN MEDICAL LABORATORY SCIENCE

THE TOTAL COST OF THE SENTARA RMH MEDICAL LABORATORY SCIENCE PROGRAM

TUITION: $_____

NON-REFUNDABLE REGISTRATION FEE: $_____ *(may not exceed $100)*

BOOKS/SUPPLIES: $_____

UNIFORM: $_____

MISC. EXPENSES: $_____

TOTAL COST: $_____

STUDENT'S RIGHT TO CANCEL

Rejection: An applicant rejected by the school is entitled to a refund of all monies paid.

Three-Day Cancellation: An applicant who provides written notice of cancellation with three (3) business days, excluding weekends and holidays, of executing the enrollment agreement is entitled to a refund of all monies paid, excluding the non-refundable registration fee.

Last date to cancel for full refund _____

Other Cancellations: An application requesting cancellation more than three (3) business days after executing the enrollment agreement and making an initial payment, but prior to the first day of class is entitled to a refund of all monies paid, less a maximum tuition fee of 15% of the stated cost of the course or $100, whichever is less.

WITHDRAWAL PROCEDURE:

A. A student choosing to withdraw from the school after the commencement of classes is to provide a written notice to the Director of the school. The notice must include the expected last date of attendance and be signed and dated by the student.

B. If special circumstances arise, a student may request, in writing, a leave of absence, which should include the date the student anticipates the leave beginning and ending. The withdrawal date will be the date the student begins leave of absence.

C. A student will be determined to be withdrawn from the institution if the student misses fourteen consecutive instructional days and all of the days are unexcused.

REFUND POLICY:

Proportion of Total Program Taught by Withdrawal Date	Tuition Refund
Less than 25%	75% of program cost
25% up to but less than 50%	50% of program cost
50% up to but less than 75%	25% of program cost
75% or more	No Refund

NOTICE TO BUYER:

1. The school does not guarantee the transferability of credits to a college, university or institution. Any decision on the comparability, appropriateness and applicability of credit and whether they should be accepted is the decision of the receiving institution.
2. The school's Grievance procedure is outlined in the school curriculum guide
3. This agreement is a legally binding instrument. Do not sign this agreement before you have read it or if it contains any blank spaces.
4. You are entitled to an exact copy of this agreement and any disclosure pages you sign.
5. This agreement and the school curriculum guide constitute the entire agreement between the student and the school.
6. The school reserves the right to reschedule the program start date.
7. The school reserves the right to terminate a student's training for unsatisfactory progress, nonpayment of tuition or failure to abide by established standards of conduct.

STUDENT ACKNOWLEDGMENTS:

1. I hereby acknowledge receipt of the school's curriculum guide/catalog dated _____, which contains information describing programs offered. The school curriculum guide/catalog is included as part of this enrollment agreement and I acknowledge that I have received a copy of this curriculum guide/catalog.

   _____Student Initials

2. I have carefully read this enrollment agreement and understand that it is a legally binding document.

   _____Student Initials

3. I understand that the school may terminate my enrollment if I fail to comply with attendance, academic, and financial requirements or if I fail to abide by established standards of conduct, as outlined in the school curriculum guide/catalog. While enrolled in the school, I understand that I must maintain satisfactory academic progress as described in the school curriculum guide/catalog and that my financial obligation to the school must be paid in full before a certificate may be awarded.

   _____Student Initials

4. I understand that the school does not guarantee job placement to graduates upon program completion or upon graduation.

   _____Student Initials

5. I understand that the school is certified to operate by the State Council of Higher Education for Virginia (SCHEV), 101 N. 14th Street, 9th Floor, James Monroe Building, Richmond, VA 23219.

   _____Student Initials

CONTRACT ACCEPTANCE

I, the undersigned, have read and understand this agreement and acknowledge receipt of a copy. It is further understood and agreed that this agreement supersedes all prior or contemporaneous verbal or written agreements and may not be modified without the written agreement of the student and the School Official. I also understand that if I default upon this agreement I will be responsible for payment of any collection fees or attorney fees incurred by _____ (school name).

By signing below, I certify that I have been provided access to the school's electronic or print curriculum guide/catalog, bulletin, or brochure.

I understand that this is a legally binding agreement. My signature below certifies that I have read, understood and agreed with my rights and responsibilities. Further, I certify that I understand the cancellation and refund policies and I understand and agree to these policies.

Signed this _____day of_____, 20_____

_____ _____
Signature of Student Date

_____ _____
Signature of School Official Date

REPRESENTATIVE'S CERTIFICATION:

I hereby certify that _____ has been interviewed by me and in my judgment, meets all requirements for acceptance as a student in the _____ (program name) at _____ (school name), as described in the school curriculum guide/catalog. I further certify that there have been no verbal or written agreements or promises other than those appearing on this agreement.

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

ESSENTIAL FUNCTIONS

(Reviewed 6/22/2026)

The following essential functions are required for admission to the program:

1. Manual Dexterity: Ability to use hand(s) or prosthetic devices with coordination.
2. Fine Motor: Ability to manipulate small objects with fingertips or adaptive devices.
3. Mobility: Ability to maneuver in the laboratory and around instruments and in patients care settings.
4. Vision: Ability to distinguish red, yellow, and blue colors; distinguish clear from cloudy, and distinguish objects through a microscope.
5. Speech: Ability to verbally communicate understandably in English.
6. Hearing: Ability to adapt with assistive devices (i.e., phone receivers, hearing aid, etc.)
7. Writing: Ability to communicate effectively in the written form in English.
8. Reading: Ability to read, understand and follow directions printed in English.
9. Psychological Stability: Ability to demonstrate the emotional health required for full utilization of the applicant's intellectual abilities. Must be able to recognize emergency situations and take the appropriate actions.

Students entering the Sentara RMH School of Medical Laboratory Science must be able to sign the following statement:

I _____ (Name) attest that I have read and understand the essential functions of the Sentara RMH School of Medical Laboratory Science and I believe that I can, and am prepared to, meet these requirements.

Signature Date

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Honor Code & Policy for Completion of Program

(Reviewed 6/22/2026)

I understand that if I cheat on an exam, practical or any type of evaluation instrument, that I will be dismissed from the school. I have read the causes for dismissal from the program, and agree to abide by the Sentara RMH Rules and I agree to abide by the honor code of the Sentara RMH School of Medical Laboratory Science, and regulations while I am a student in the school.

I have read the information for progression through the program found in the Curriculum Guide. I understand the necessary requirements for progression in and completion of the program.

By signing this document I attest to the above stipulations.

_____ _____

Student Signature Date

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Health and Safety Policy Signature Sheet

(Reviewed 6/19/2026)

I acknowledge that I have received instructions on health and safety during my hospital orientation class and Sentara RMH School of Medical Laboratory Science Orientation course.

I understand this material and agree to adhere to the health and safety policies to include biohazard and safety training. Additional safety training will be in the School of Medical Laboratory Science Student Lab and during clinical rotation.

_____ _____

Student Signature Date

Sentara RMH School of Medical Laboratory Science

Confirmation of Knowledge of Rules and Regulations

(Reviewed 6/19/2026)

As a student of the Sentara RMH School of Medical Laboratory Science, I agree to abide by the code of ethics and the general rules and policies of the school and the hospital, and I am responsible for my conduct at all times. In signing below, I also affirm that to the best of my knowledge, the application information is correct and accurate.

Signature Date

Consent for Photography/Videotaping/Interview

(For Media, Public Relations, Marketing, and Educational Purposes)

Date: _____

❑ SENTARA EMPLOYEE ❑ PHYSICIAN
❑ AGENCY/COMPANY ❑ OTHER: _____
❑ FAMILY MEMBER

Name (Print): _____

Street Address: _____ **City:** _____

State: _____ **Zip:** _____ **Phone:** _____

E-Mail: _____

I consent to interviews, photographs, or videotapes of me or my family member(s), that may disclose personal health information, for use, reproduction, and/or publication by Sentara Healthcare and its affiliates ("Sentara"), and authorize release by Sentara to other organizations or news outlets, including local, regional, national, and international print, broadcast, and internet media.

I understand and agree that these images and interviews, including my image, likeness, and/or voice, may be used in the news or by Sentara for purposes of education, promotion, public relations, and/or marketing, and that they may appear in print, on television, in radio broadcasts, or on the internet. I understand that there is a possibility that I may be identifiable in these photographs, videos, or written/audio accounts, though my name will not be published unless I specifically agree below.

❑ I DO ❑ I DO NOT Consent to the use of my name (or the patient's) with these photographs or videos.

I agree to release and hold harmless Sentara, its trustees, agents, officers, and employees from any and all liability which may arise from the making of or use of these photographs, videotapes, or interviews, and I will not request payment for the use of my image or likeness.

I understand that signing this authorization is strictly voluntary and that I may revoke it at any time. However, I acknowledge that any interviews or images to which I consented prior to revocation may already be in the public realm and not retrievable. I also understand that any personal health information released by me under this consent will no longer be protected by federal privacy regulations.

_____ _____

SIGNATURE (OR SIGNATURE OF GUARDIAN IF A MINOR UNDER 18 YEARS OLD) DATE

Person responsible for photo shoot / videotaping / interview session: (PLEASE PRINT)

_____ _____ _____

NAME TITLE ORGANIZATION

NOTES:

_____

_____

_____

EXHIBIT E
Statement of Responsibility & Confidentiality

All employees of Sentara Health and any individuals who have access to Sentara Health information, files, data, or computer applications must sign and follow this statement of responsibility and confidentiality.

1. I understand and agree that any information I learn during my employment and/or affiliation with Sentara Health regarding patients/families, physicians/dentists/limited health practitioners is confidential. I agree not to use, view, discuss, disclose, duplicate, alter or destroy such information **unless my job requires it**. Further, I will not give such information to anyone who does not have authorized access to it, attempt to learn confidential information not required by my job or discuss such information when participating in social media or other internet sites (i.e., posting of information, photographs, etc.).

2. I understand this statement also covers all passwords issued to or used by me to operate Sentara Health computer systems. Therefore, I agree not to tell my passwords to anyone for any reason, not to permit another person to use them, not to use another person's, and not to sign on to any system to allow an unauthorized person to use the system. Further, since my passwords are the equivalent of my legal signature, I agree immediately to change or have changed passwords that have become known to other people.

3. I understand and agree to follow all Sentara Health security policies and procedures of specific computer systems to which I am given access. I also understand if I have not used my access to a certain system within 90 days, my access to it may be suspended, and if I have not used it in 90 days, my access may be deleted.

4. I understand that I am responsible for logging off a system session if I leave the vicinity for the system workstation. I further understand that if I fail to log off the system session, I will personally be held responsible for any activity performed on the system after I left the workstation vicinity.

5. I understand and agree that I am responsible for Sentara Health resources, material, and data in my possession. I will take precautions to protect them from theft, temperature changes, water damage, and other intentional damage; I understand that if I do not take reasonable precautions, I may be held liable for any damage incurred.

6. Although incidental and occasional personal use of Sentara hardware, software, and data is permitted, I understand that excessive personal use or inappropriate use of any Sentara resources, material, and data may result in disciplinary action up to and including termination and also agree not to allow another person to use them for personal use while they are in my possession. I acknowledge that I represent the company when using Sentara hardware, software, and data and will not participate in any activities that are unlawful nor will I release protected health information, Sentara trade secrets and other confidential business material of Sentara gained as a result of my position. I understand that any actions I take in the computer-based information systems are tagged with my unique identifier as established in my user profile and such actions can be traced back to me.

7. I agree to respect copyright laws and not to make unauthorized copies of copyrighted material, and I understand that I will be held personally liable for any unauthorized copies of copyrighted material made by me.

8. I understand all patient medical information is confidential and agree to treat it as such. I further agree

that I will use and disclose such information only in accordance with state and federal laws, including, but not limited to, the regulations promulgated under the Health Insurance Portability and Accountability Act of 1996 ("HIPAA").

9. Even if not technically enforceable, and to the extent possible, I will ensure that my passwords comply with the password Management Policy to the extent that a particular password is capable of compliance. For example, if the system can only accept a 6-character password, 6 characters will be sufficient.

I have read and understand the above and acknowledge that it is my responsibility to adhere to this Statement of Responsibility & Confidentiality at all times. I agree that any violation of this understanding and agreement will result in my losing access to computer systems and is grounds for corrective action that may result in dismissal. Sentara Health will retain the original signed copy of this Statement of Responsibility and Confidentiality.

User Name _____ **Date**_____
(Please print your first, middle, and last name)

User Signature_____

Academic Institution Name _____

EXHIBIT D
Participant Acknowledgement

In consideration for being permitted to participate in an educational program, clinical rotation, practicum, or other educational experience (the "Program") at Sentara Health ("Sentara"), the undersigned student or staff/faculty member of the academic institution ("Participant") agrees as follows:

1. **Assumption of Risk.** Participant understands and acknowledges that participation in the Program may involve exposure to risks, including but not limited to risks of personal injury, illness, or property damage, and that such risks may arise from, among other things, exposure to patients, use of medical equipment, or travel to and from Sentara. Participant knowingly and voluntarily assumes all such risks.
2. **WAIVER AND RELEASE OF LIABILITY**. TO THE FULLEST EXTENT PERMITTED BY LAW, PARTICIPANT RELEASES AND DISCHARGES SENTARA, ITS OFFICERS, DIRECTORS, EMPLOYEES, MEDICAL STAFF, AND AGENTS FROM ANY AND ALL CLAIMS, DEMANDS, DAMAGES, LIABILITIES, OR CAUSES OF ACTION, WHETHER KNOWN OR UNKNOWN, ARISING OUT OF OR RELATING TO PARTICIPANT'S PARTICIPATION IN THE PROGRAM, EXCEPT TO THE EXTENT CAUSED BY THE GROSS NEGLIGENCE OR WILLFUL MISCONDUCT OF SENTARA.
3. **Financial Responsibility.** Participant understands that Participant is responsible for the cost of any medical care Participant receives from Sentara, for any reason, and for the costs of travel, lodging, meals, and all other personal expenses.
4. **No Employment Relationship**. Participant acknowledges that participation in the Program does not create an employment relationship with Sentara and that Participant is not entitled to wages, workers' compensation benefits, or other employment-related benefits from Sentara.
5. **Removal.** Participant acknowledges that Sentara retains the right to remove any Participant at any time in its sole discretion and that Participants receive no procedural rights prior to such decision by Sentara.
6. **Compliance with Rules and Orientation**. Participant agrees to comply with all applicable laws, regulations, and Sentara policies and procedures, including those relating to background checks, confidentiality, privacy, and safety and supervision of clinical activities. Participant understands that Participant is required to complete orientation and onboarding as assigned by Sentara, and agrees to complete such orientation prior to beginning assignment at Sentara.
7. **Work Product Limitations.** Participant understands that any educational work product (*e.g.*, school reports) pertaining to Participant's experience at Sentara shall not contain confidential or patient information. If Participant has any question as to the appropriateness of any work product, and/or upon Sentara's request, Participant will submit a copy of educational work product to Sentara for review prior to publication or disclosure.
8. **Acknowledgment.** Participant acknowledges that Participant (a) has read this form, including the Assumption of Risk and Waiver and Release of Liability, (b) understands its terms, and (c) signs it voluntarily.

_____		_____
Participant Signature	Date	Participant Role (e.g., student, faculty, etc.)
_____		_____
Printed Name		Academic Institution

Sentara

Job Aid:	IP&C Hand Hygiene Competency Tool		
Manual:	Infection Prevention & Control	**Original Date:**	11/21/2023
Section:	Aseptic Techniques	**Revision Date:**	
Location(s):	SAMC, SCH, SHRH, SLH, SMJH, SNGH, SNVMC, SOH, SPAH, SRMH, SVBGH, SWRMC, SASD	**Approved By:**	IPPF, EOHS
		Process Owner:	Infection Prevention & Control

Revision Description (Most Recent):

Employee: _____ Date: _____

To be completed upon hire during orientation or as needed for refresher training.

Purpose:
To provide Employee Occupational Health with guidelines to assess hand hygiene competency among staff and others as necessary.

Definitions:
EOHS – Employee Occupational Health Services
IPPF – Infection Prevention Practice Forum

Sentara Hand Hygiene Competency Tool



World Health Organization (WHO) "5 Moments for Hand Hygiene": Before and after direct contact with a patient's intact skin, before performing a clean/aseptic procedure, after contact with patient equipment or the patient's environment, after body fluid exposure **risk** (i.e., emptying foley bag or bedpan).

Hand Hygiene Opportunities: Sentara prioritizes use of alcohol-based hand sanitizer for most hand hygiene opportunities. Use of soap and water is required before eating, after using the restroom, and when exiting a Contact Enteric Precautions patient room.

Use only Sentara-approved soap, alcohol-based hand sanitizer, and lotion.

Peer Checking/Peer Coaching: Provide positive feedback when hand hygiene is done correctly and always remind others (if they are about to have a lapse) and /or coach HH noncompliance – *All Hands on Deck!*

Hand Hygiene Using Soap & Water	Competent	
	Yes	No
Preparation: Ensure sinks are supplied with soap, paper towels, and a trash can. Use warm water.		
Apply enough soap for both hands, between fingers, up to wrists to about where gloves end. Must use hospital-approved soap.		
Scrub time must be **≥20 seconds** using friction.		
Wash all hand surfaces: The "5" Maneuvers a. Rub palms of hands, backs of hands, then palms again with interlocking fingers. b. Cup hands & fingers and rotate (to get the tops of fingernails and tips of fingers). c. Rub using rotation around thumbs. d. Rub fingertips to palms (to get the underside of fingernails and tips of fingers). e. Rub using rotation around wrists.		

**ATTENTION: FOR REFERENCE USE ONLY WHEN PRINTED;
PLEASE REFER TO ELECTRONIC DOCUMENT FOR MOST CURRENT VERSION**

Rinse thoroughly under running water with fingertips pointed down.		
Dry hands thoroughly with clean paper towels.		
Use paper towel to turn off faucet to prevent contamination of clean hands.		
Hand Hygiene with Alcohol-Based Hand Sanitizer		
Apply enough hand sanitizer to cover all surfaces of hands and wrists for the entire process (hands should not be dry in 10 seconds).		
Dispense appropriate amount of hand sanitizer. Rub hand sanitizer vigorously over both hands up to ½ inch above wrists.		
General Observations – Nail Hygiene		
For all nails, regardless of clinical or non-clinical facility: ▪ Nails and nail bed must appear clean. ▪ Nails must not be chipped or ragged. **For clinical and patient-facing facilities:** ▪ Length no longer than ¼ inch. ▪ Nail polish must be easily wiped off/removed with nail polish remover. Nail products requiring a soak in nail polish remover are not permitted. ▪ Note that some areas, e.g., Surgical Services, may have more restrictive nail policies.		
Skin should be intact without open wounds, rashes, etc.		

Signature of observer:_____

Related Documents:

Policy	IP&C All Hands on Deck
Procedure	IP&C Hand and Fingernail Hygiene
Job Aids	IP&C Isolation Categories Chart
Regulatory References	Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Setting 2007 Guidelines for Hand Hygiene in Healthcare Settings, 2002 Department of Health Food Safety Regulations 2002 CDC Hand Hygiene in Healthcare Settings: Hand Hygiene Guidance, 2020 World Health Organization Hand Hygiene Guidance SHEA IDSA HH Practice Recommendations WHO 5 Moments for Hand Hygiene

ATTENTION: FOR REFERENCE USE ONLY WHEN PRINTED;
PLEASE REFER TO ELECTRONIC DOCUMENT FOR MOST CURRENT VERSION

SRMH SCHOOL OF Medical Laboratory Science

Volunteering for Phlebotomy Procedures
Release and Indemnity Agreement

I, (print name) _____, being over 18 years of age (if under 18, Parents/Guardian must sign), hereby acknowledge and agree to participate in a venous blood sampling where venous blood will be drawn from me by venipuncture or finger sticks by fellow students.

I am aware that possible complications, discomfort and risks may arise from this procedure. I also acknowledge that the student performing the procedure is a student presently learning phlebotomy and is not experienced in any of these procedures.

I hereby release and discharge and agree to hold harmless and defend the Sentara Healthcare, it's officers, directors, employees and affiliates from and against any and all injuries claims, damages, liabilities, costs and expenses whatsoever, including reasonable attorney fees, which I or anyone on my behalf may claim to have arisen or occurred in connection with my participation in the clinical practices.

This release shall be binding upon me and anyone who succeeds to my rights and responsibilities, such as my heirs, personal representatives or executor of my estate.

Volunteer signature _____ Date _____

Phone # _____

Signature of Parent or Guardian (if under 18 years of age) _____

Program Director Signature _____ Date_____

Instructor Signature _____ Date_____

SENTARA®

Sentara Healthcare Department Orientation Checklist

This form should be completed within 30-days of someone starting in your department.

Employee/Non-Employee Name (Print) Title Department Date

	Date	Initials of Orientee	Initials of Preceptor
Sentara Mission Statement – "We improve health every day"			
Introductions to staff/manager			
Tour of unit/facility, a Tobacco-Free campus			
Location of restrooms, break room, equipment, supplies, etc.			
Emergency codes review and number to call for emergencies (12)			
Location of fire extinguishers, pull boxes, fire plan, routes, RACE/PASS			
Hazardous Materials Safety Data Sheets access			
Infection Prevention and Control - personal protective equipment and where to locate, isolation precautions, handling exposures, eye wash station and procedure, *physically demonstrate proper hand hygiene (5 maneuvers)			
Video Remote Interpreter			
Dress code, badge requirements, specific unit/dept. policies			
HIPAA and privacy requirements			
Other: (Please list)			

Employee/Non-Employee Signature _____ Date: _____

Manager Signature: _____ Date: _____

Do not draw lines down page; each box needs to be filled in with date/initials.

Sign and retain a completed copy in the education folder. Additional department orientation material may be added as required.

Rev: 5/11/2022

*SWRMC Revision: Added Demonstrate proper hand hygiene (5 maneuvers)

Online Orientation Training

(Revised 5/6/24)

Complete all modules which have been assigned on Sentara Work Day by 6/19/26.

Section 7

Sentara®

School of Medical Laboratory Science

Harrisonburg, Virginia

Safety Policies

(Updated 8/18/2026)

Student Safety

All students must follow the safety policies of Sentara and the school. Student safety is of the utmost concern for Sentara and the school, and precautions to protect that safety will be maintained. Safety policies required by CAP and DNV and other accrediting agencies will be followed by Sentara and the school.

During the first weeks of the didactic portion of the program, students will receive instruction regarding the school Fire Plan and Student Lab safety.

At the start of the clinical rotation, students will be provided with a safety orientation by their preceptor in Sentara Lab Services.

Laboratory Accidents

All laboratory accidents are to be reported immediately to one of the following:
Program Director
Laboratory Administrative Director
One of the laboratory managers
A **STARS Report** will be completed and filed, and any necessary medical attention promptly given. It is imperative that ***all*** accidents, no matter how minor, be reported.

Students in the medical laboratory science program are responsible for observing and following all hospital policies. The student is encouraged to review the laboratory policy manual upon entrance into the program. A copy of the manual is located in each clinical section.

Sentara RMH Laboratory Schools Fire Plan

Purpose: To delineate procedures to be followed by staff and students of Sentara RMH School of Medical Laboratory Science, Sentara RMH School of Histotechnology and School of Phlebotomy in the event of a fire until the arrival of the local fire department.

Procedure:

1. All employees will follow the procedures described by the acronym 'RACE' as outlined in the hospital procedure manual.

    R **Remove/rescue** all students or visitors who are in immediate danger
    A **Activate** the nearest fire alarm by calling 911
    C **Confine** the fire by closing all doors/windows
    E **Extinguish** the fire until the arrival of the Fire Department

2. There are three fire pulls in the building, located at each of the three exits. In case of fire, proceed to closest exit to activate the alarm. Emergency lighting is located at each exit.

3. There are smoke detectors located throughout the building; employees should observe where they are located in their work areas.

4. There are **7 fire extinguishers** located in the building:
    A. At both ends of the front hallway (2)
    B. At both ends of the back hallway (2)
    C. Breakroom
    D. MLS student laboratory
    E. HTL student laboratory

5. There are **3 exits** located in the building:
    A. Front door of the building
    B. At both ends of the back hall

General Fire Plan

1. **Inform:** The urgency and degree of the evacuation is a judgmental matter, depending on the situation. Some fires may require partial or total evacuation.

    A. Decision to evacuate the department shall be made by the Program Director

2. **Report:** The fire is reported by following the steps outlined below:
    A. Call in a loud voice, "Attention…a fire has been located in the building. Please remain calm and report to the nearest exit."
    B. Call 911

3. **Contain:** To prevent the spread of fire and smoke, close all windows and doors but do not lock them. A confined fire will gain less headway and spread less smoke to other areas.

4. **Fight fire:** After making sure everyone in the building is safe, and reporting fire, immediately start to extinguish or control fire. Follow the procedures delineated by the acronym PASS as outlined in the hospital procedure manual:

    P Pull
    A Aim
    S Squeeze
    S Sweep

5. **Evacuation:** If it is not safe to attempt to extinguish the fire, the area should be evacuated. Muster point for the building is the bus stop on Technology Drive.

Staff Responsibilities:

A. Ascertain the location of the fire
B. Implement fire plan
C. Communicate with staff and students
D. Evacuate students to nearest exit
E. Inform arriving fire department
F. Notify supervisor

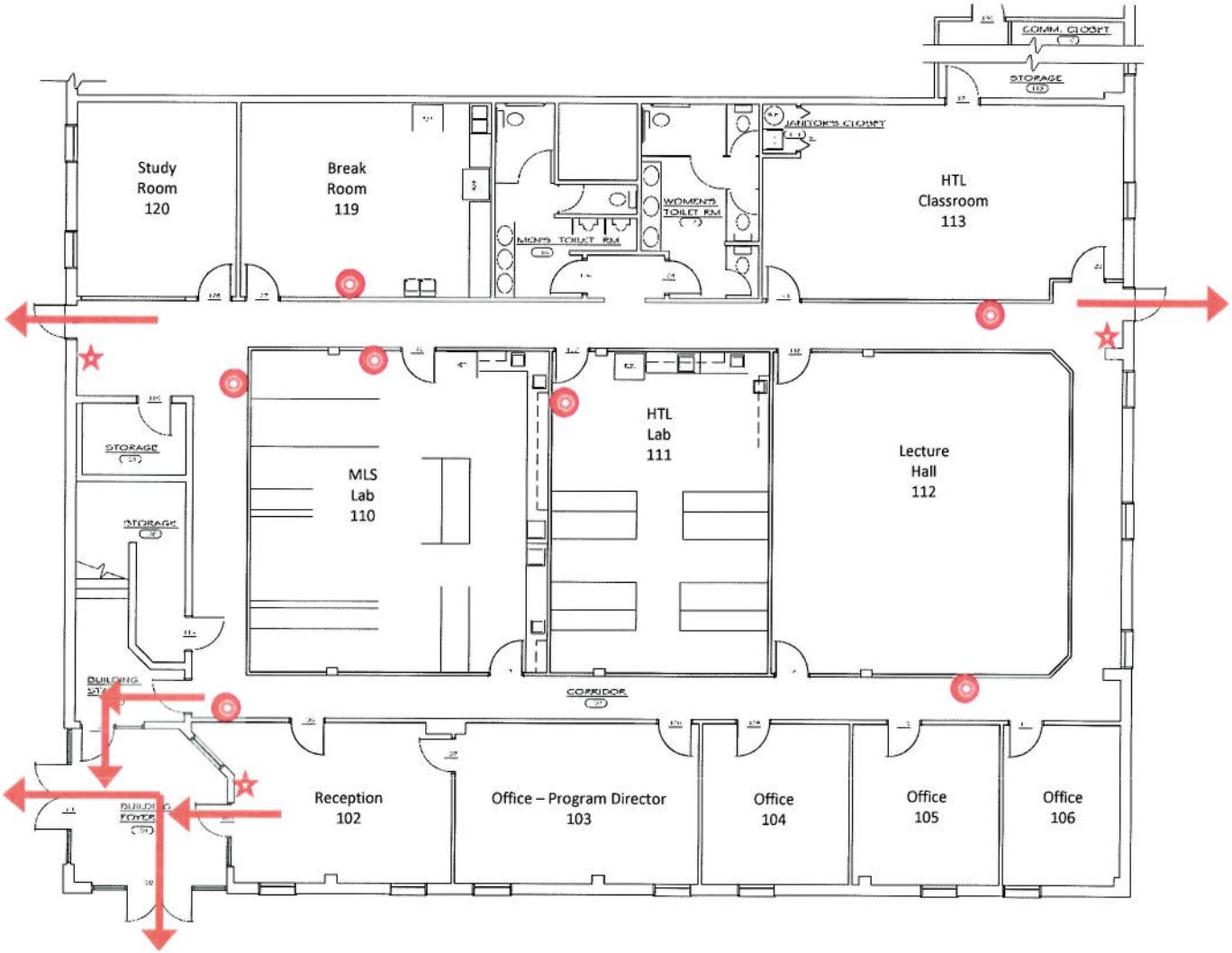
Training:

A. New personnel orientation will include a review of the departmental plan.
B. Each new class of students will be educated on the departmental plan, their roles, their evacuation routes, and the principals of RACE and PASS.
C. Employees will be inserviced annually on the departmental plan, their roles, their evacuation routes, and the principals of RACE and PASS.

FIRE PLAN

Sentara RMH Medical Center School of Histotechnology (HTL) and School of Medical Laboratory Science (MLS)
Building Located at 1401 Technology Drive

= Fire Extinguisher =Fire Pull Station



Muster point for the building is the bus stop on Technology Drive.

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Inclement Weather Policy

(Revised 6/4/2025)

The **Sentara RMH School of Medical Laboratory Science** will follow the inclement weather decisions—specifically **closures and delays**—of local colleges and universities based on each student's assigned location. This applies to hazardous weather conditions including, but not limited to, **snow, ice, flooding, hurricanes, and tornadoes**.

Harrisonburg Area

For students located at the **Sentara RMH campus in Harrisonburg**, the School will follow **James Madison University (JMU)** for weather-related closures and delays.

- If JMU is closed due to **snow, ice, hurricanes, tornadoes, or flooding**, Sentara RMH classes will also be **closed**.
- If JMU announces a **2-hour delay**, Sentara RMH classes will also operate on a **2-hour delay**.

Norfolk Area

Students on rotation at **Sentara Hospitals in the Norfolk area** will follow **Old Dominion University (ODU)**.

- Any weather-related closures or delays at ODU—including **flooding, hurricanes, snow, or tornado warnings**—will be reflected in Sentara RMH's schedule for those students.

Halifax Area

Students on rotation in the **Halifax area** will follow **Southside Virginia Community College (SVCC)**.

- If SVCC announces a weather-related closure or delay due to **snow, ice, flooding, or other severe weather**, Sentara RMH students in that region will follow the same schedule.

Charlottesville Area

Students on rotation in **Charlottesville** will follow **University of Virginia (UVA)**.

- Weather-related decisions at UVA—including those due to **tornadoes, heavy flooding, hurricanes, or winter weather**—will determine the schedule for Sentara RMH students in the area.

Woodbridge Area

Students on rotation in **Woodbridge** will follow **George Mason University (GMU)**.

- Any delay or closure due to **snow, ice, severe storms, or flooding** at GMU will also apply to Sentara RMH students in the Woodbridge area.

Important Notes

- This policy applies **only to closures or delays due to inclement weather**.
- Announcements for closures or delays will be made through **local radio, television, and university websites**.
- Students are expected to monitor the appropriate university for their region and communicate with program faculty as needed.

Section 8

SRMH School of Medical Laboratory Science

Harrisonburg, Virginia

General Policies

(Reviewed 4/22/2026)

Grievance Procedure (Academic and non-academic grievances will follow the same policy, and will be addressed in the same manner.)

Students are encouraged to maintain open lines of communication with faculty. This will promote discussion of any problem that may arise. If for any reason, the student feels that they have been treated unfairly, they may proceed with the grievance procedure. This grievance procedure will apply to an academic and non-academic grievance. It is as follows:

1. The student will bring the charge in writing to the program director within two weeks of the action or occurrence.

2. A response will be made by the program director within two weeks.

3. If the student is not satisfied with the ruling of the program director, they may file a written complaint to the laboratory administrative director.

4. The laboratory administrative director will make a ruling on the complaint.

5. If the student is not satisfied, the grievance committee will be convened, at the written request of the student. The panel will be made up of seven members. These will include the program director, SRMH laboratory administrative director, a student from the current class, SRMH education coordinator of MLS school, education coordinator for MLS school at Sentara, one member from the SRMH Human Resources Department, and one member of the faculty from one of the university affiliates of the SRMH School of Medical Laboratory Science (if possible, this member will be from the college the student attended). This committee will meet within two weeks of the written request from the student. The results of the grievance committee will be the final decision. The committee will give the final report within two weeks of the meeting to the student and any other parties involved. Waivers of the above stipulations may be granted if agreed to by all parties.

The student may contact the State Council of Higher Education as a last resort.

State Council of Higher Education for Virginia (SCHEV)
Private and Out-of-State Postsecondary Education
101 N. 14th Street
Richmond, VA 23219

Tuition

The tuition for the year is $5000.00 for all students regardless if that student pays tuition to a university. Tuition must be paid before classes begin in all cases. Tuition must be paid in full. There are no installment payments available. The school does not offer any types of financial aid. One fee for the year of $100.00 is collected when the student accepts a position in the school. The $100.00 fee is nonrefundable. Accepted students will be sent a list of required textbooks. These are purchased by the student and brought the first day of class. The school does not participate in the federal student aid program.

Health Care

Each student must have and is responsible for obtaining an adequate health insurance policy during the clinical year. Evidence of this health insurance coverage must be demonstrated upon entering the Program. Any medical services administered are the financial responsibility of the student.

Emergency Room services and other hospital services are available to students Students injured as a result of a laboratory or hospital accident will be taken to the hospital emergency room for any necessary treatment. The student will be responsible for any expenses that are charged by the emergency room for such a visit.

Liability Insurance

The SRMH Healthcare will cover students with liability insurance while they are enrolled in the program.

Leave of Absence (Voluntary Withdrawal)

In reference to voluntary withdrawal or leave of absence, re-admission to the program is contingent upon past records and space availability. Re-admission of students dismissed for academic or disciplinary reasons would not be considered unless such dismissal was due to illness or other correctable circumstances. Students have the right to appeal.

It is recognized that interruptions may occur for various acceptable reasons, such as an accident, illness, or pregnancy. Each request for interruption of the program will be considered on an individual basis. When a subject has been completed in its entirety, including both lecture and clinical rotation, credit will not be lost by interruption of the program. Partial credit would be given if at least three months of the program had been completed. Re-entrance for such interrupted training is dependent on space availability, academic standing at the time of the interruption, and length of interruption interval. Interrupted training must be reinstated within a two-year period.

A student who does not resume attendance on the return date following a leave of absence will be terminated by the program.

Withdrawal Policy

A student may withdraw from the Program at any time. A completed transcript of grades is generated for each student at graduation. Transcripts are not generated for students who do not finish the program. The withdrawal/cancellation must be made during the three (3) day cancellation period. For 100% refund

of tuition, withdrawal must be made during the three (3) day cancellation period. Withdrawal should be submitted in writing with student signature.

Student Counseling

There is an open-door policy with the program director and the education coordinator. Students may seek advice or counseling at any time throughout the year.

One formal counseling session with the program director and the education coordinator will be scheduled. Additional formal sessions will be held if the student is experiencing problems.

If a student has concerns/problems within the didactic phase of the Program, the student should first discuss the matter with the respective instructor. If not satisfied with the response, the student may then contact the Program Director for further discussion.

After each rotation, the student will receive an evaluation completed by the department. This is an additional opportunity for the student to receive counseling when this evaluation is discussed between the Program Director and the student.

During the clinical rotation portion of the program, the program director and education coordinator will contact the student regarding career planning. Students will be advised on how to write a resume and will be given information regarding job openings both within Sentara labs and at other healthcare facilities.

Faculty will be available 30 minutes before or after each class for academic and/or course advising to students. There are no placement services offered by the school.

Parking

Parking is available in the lot next to the building. Please leave parking along the building for faculty and guests.

Professional Dress Code

Black scrubs must be worn at all times according to the Sentara RMH Healthcare dress policy. Scrub colors for rotation at other Sentara hospitals may vary. No flip-flops or open-toed shoes may be worn. If dress is not appropriate, the student will be asked to leave and not return until appropriate dress is worn. Any infractions will be noted in the student's permanent record.

Substance Abuse Policy

SRMH Healthcare has a strong commitment to its employees and patients to provide a safe work place and to establish programs promoting high standard of employee health and wellness. The Hospital's goal will continue to be one of establishing and maintaining a work environment that is free from: (A) the effects of illegal drugs, (B) the effects of alcohol, and (C) the abuse of legal drugs and substances. The Hospital recognizes that serious involvement with drugs or alcohol eventually takes a toll on an individual, family and the organization. Students having a drug or alcohol problem are strongly encouraged to seek outside professional assistance.

Students are subject to abide by Sentara Policy.

Sentara RMH School of Medical Laboratory Science

General Rules for Classrooms

(Revised 6/2/2020)

1. Behavior should be professional at all times this includes; showing respect to fellow students and instructors with seating posture and body language during class and between classes. Use of profanity is not acceptable.

2. No food in the classroom or student lab. Drinks are permitted in the lecture room only, not in the lab. Please be careful not to spill drinks on the floor, all drinks must be in a container with a lid.

3. Do not move or rearrange tables and chairs without permission of the instructor.

4. School library books are for use in classrooms only. Please ask the Program Director if you wish to sign out a book.

5. You may have your cell phones in the classroom but should be set to silent during lecture.

6. No cell phones or any electronic devices permitted in the student lab without permission of instructor. For exam purposes you will need to leave your phone or any electronic devices out of the classroom.

7. Only non-programmable calculators may be brought to the test room.

8. Students are not allowed in the faculty offices unless the faculty instructor is present.

9. No sleeping in the school during class or between classes. Students found sleeping will be asked to return home until properly rested before returning to class. No lying on the floor of the classroom or student lab at any time

10. Noise should be kept to a minimum because we share the building with other classes and offices.

11. During exams no personal belongings will be permitted in the classroom other than your pencil and calculator.

12. All valuable items should be placed in your school locker or vehicle, the school will not be responsible for anything lost or stolen.

Sentara RMH School of Medical Laboratory Science

Harrisonburg, VA.

CAUSES FOR DISMISSAL

(Reviewed 4/23/2026)

1. Failure to maintain a grade point average of 70% in any course or clinical rotation
2. Failure of three consecutive lecture tests in one subject or five quizzes in one subject.
3. One unsatisfactory clinical rotation test, evaluation, or practical.
4. Cheating on any type of evaluation (tests, practical exams, or oral exams etc.)
5. Failure to pass the Comprehensive Exam with a 70%.
6. Failure to follow the rules and instructions of the Student Lab resulting in a failing grade of less than 70% on two or more student labs.
7. Falsification of application materials.
8. Excessive absenteeism and tardiness as addressed in the Sentara RMH School attendance policy.
9. Gross neglect of duty, insubordination, dishonesty or misappropriation of hospital property.
10. Incompetence, falsification of records, disorderly conduct, soliciting for tips.
11. Willful destruction of hospital property.
12. Habits or state of health dangerous to the student, to other students, employees or to patients.
13. Alcohol and/or drug abuse-includes drinking or being drunk on the job.
14. Gambling on hospital premises.
15. Harassment of staff, fellow students or patients.

16. Failure to follow the rules and regulations of Sentara RMH and the school to include the Professional Dress Code.

17. A violation of 2 or more Sentara Red Rules as listed; for example, misidentification of patients or reporting inaccurate results on a didactic or rotation practical exam.

Dismissal from the program for academic reasons will be the last resort. Students will be placed on academic probation and may be offered the chance to repeat the program prior to being dismissed.

All non-academic violations will be brought by the Program Director to the Advisory Committee for review prior to student dismissal.

Students wanting information about their status should contact the school in writing with signature. The school will respond to the student in writing within two weeks of the request for information. Communication regarding dismissal should be in writing between the student and the school.

Policy:	Colleague Professional Appearance 109		
Manual:	Human Resources	**Original Date:**	9/1/1998
Section:	Employment	**Revision Date:**	7/15/2025
Location(s):	Sentara Health and its direct and indirect wholly-owned and/or majority-owned subsidiaries, including SAMC, SCH, SHRH, SLH, SMJH, SNGH, SNVMC, SOH, SPAH, SRMH, SVBGH, SWRMC	**Approved By:**	Executive Vice President & Chief People Officer
		Process Owner:	Human Resources
Revision Description (Most Recent):	Updated the expectations that all colleagues are on camera when on a video conference.		

Policy Statement:

At Sentara Health, we understand and appreciate the diverse backgrounds and personal expressions of our team members. We believe that our collective appearance plays a role in fostering a positive work environment, strengthening our organizational culture, and enhancing our reputation. Together, we aim to present an image that helps build trust with those we serve. This policy not only prioritizes safety and professionalism but also seeks to uphold the dignity and respect of every team member.

General Guidelines

We trust and encourage our team members to select apparel and grooming styles that reflect professionalism and align with their roles.

1. Please ensure your attire is clean, neat, professional, and respectful.
2. Clothing shall be free of pictures, advertisements, and endorsements, except with senior leadership approval (i.e., the President), who can approve Sentara logo gear, spirit week attire, holiday celebrations, etc.
3. Shoes should be appropriate for a professional work environment, clean, and in good condition.
4. For those who love accessorizing, let's ensure our jewelry choices are safe and suitable for our roles.
5. Fragrances should be used sparingly, as they may irritate those who have sensitivity to fragrances.
6. We appreciate and respect personal expressions like tattoos and body art. Let's ensure they convey respect and understanding for all. A leader may ask you to cover a tattoo or body art (i.e., bandage or article of clothing) if the tattoo is potentially offensive or controversial to co-workers, patients, members, vendors, or others (i.e., violence, nudity, illegal substances, weapons, etc.).
7. ID Badges with a current official picture and in good condition shall be worn and visible for our consumers and colleagues to identify one another easily and for security purposes.
8. Attire for business units/departments or occupations that have executive leadership approval may adopt a uniform that includes khakis and polo shirts.

Expectations for Direct Patient-Care Occupations and Environments

Uniform, designated clothing, jackets, and/or scrubs as applicable for the assigned occupation shall be worn and maintained by you.

1. All uniforms and clothing shall be worn in accordance with established color guidelines, in good condition, and cleaned daily to ensure prevention of infection risks to our patients.
    a. Home laundering of clothing and departmental uniforms shall be performed according to the manufacturer's recommendations and not mixed with items used for environmental cleaning/disinfection in the same load. Home laundering is not allowed for surgical/procedural area scrubs.
    b. Clothing worn prior to changing into hospital-provided scrubs should be clean and professional.
    c. Clothing shall be free of pictures, advertisements, and endorsements, except with senior executive approval (i.e., President), who can approve Sentara logo gear, spirit week attire,

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holiday celebrations, etc.

2. Headwear required for safety reasons or as part of a department uniform are appropriate.
3. Shoes shall be clean and appropriate to the uniform in the area and the type of work performed.
    a. Per OSHA regulations, open-toed shoes/sandals are prohibited in any patient care/clinical areas.
    b. Footwear worn by clinical staff shall be professional/hospital/clinical grade, solid surface made of non-absorbent and non-perforated materials (i.e., no perforated CROC style clogs or shoes constructed of nylon or canvas materials.) If clogs are loose fitting, the heel strap shall be worn.
    c. Shoe covers should not be worn outside of your immediate patient work area.
    d. Department specific shoes may be required, such as designated color, slip resistant soles or shoes with hard toe for safety.
4. Hair shall be clean and not pose a safety hazard when performing assigned job duties.
    a. Facial hair may not inhibit N95 respirator for those positions requiring fit testing.
5. Fingernails shall be natural, clean, unchipped, and maintained at a length shorter than one-quarter inch past the tip of the finger. For more information, please refer to the Infection Prevention & Control Procedure #204 Handwashing/Hand Hygiene/Fingernail Hygiene.
6. Fragrances should not be used in clinical and patient care areas.
7. Personal Protective Equipment (PPE) shall be worn in accordance with the procedures/processes for your position. You are responsible for:
    a. Understanding and adhering to the process of Standard Precautions.
    b. The proper use of personal protective equipment.

Expectations for Environments Where Patients or Consumers Are Not Seen Daily

In Sentara divisions where we don't see patients or members daily, we embrace a professional casual dress code to nurture a respectful and polished work environment. Our intention is to foster a culture of professionalism while providing some flexibility in attire choices. We trust our colleagues to make clothing choices that align with our company's values and mission. We encourage our colleagues to embrace the following guidelines:

1. Attire should mirror professionalism, such as dress slacks, skirts, and collared shirts/blouses. While a blazer or suit jacket is an option, you are encouraged to select clothing that presents a professional image.
2. Closed-toe footwear or dress shoes are preferred. Sneakers, flip-flops, and overly casual footwear should be avoided. If you plan to visit a patient care facility, closed-toe shoes are recommended for safety reasons.
3. We celebrate Fridays as a day of relaxation and camaraderie. On Fridays, you are encouraged to embrace a more relaxed dress code, allowing well-kept jeans. Please ensure they are clean and free of holes or excessive wear.
4. For meetings, presentations, client interactions or other special occasions, you are encouraged to elevate your professional casual attire, which may include wearing a blazer or more formal clothing.
5. Some departments or roles may have specific dress code recommendations. We invite you to consult with your supervisor or HR for any needed clarification.

Expectations for Video Conferencing

All Sentara colleagues are expected to have their cameras on during video conferences. Your attire should be professional and appropriate to your role and the meeting's context.

Expectations for ID Badges

Upon employment, Sentara Health provides all colleagues and contingent workers with an identification badge to be worn while at work, which must be displayed appropriately with the picture side visible to consumers and coworkers at all times. All colleagues with onsite and hybrid work status, and contingent workers, are required to obtain an ID badge on the first day they work onsite at a Sentara location. Colleagues with remote-only worker status are required to obtain an ID badge if they perform in consumer-facing positions or if directed to by their supervisor.

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The ID Badge clearly identifies the individual as a Sentara colleague. This badge must be returned to the colleague's manager at the time of employment separation from Sentara Health. Photos on the badge must be renewed every 10 years or in any situation where there is a significant change to appearance, or if the photo has been damaged and is no longer recognizable. The badge is also used for recording time worked (see Recording Time Worked Policy 401 for details). This badge is also used to access secure areas and computer programs.

The identification badge bears a photo of the individual, first name and last name initial, job title, and division/location. Sentara colleagues in Director-level or above positions must have their full last name displayed. Only the individual to whom it was issued may use the badge. Any colleague who allows another to use their badge or uses another colleague's ID badge will be subject to disciplinary action. This disciplinary action is defined in the Human Resources Policy: Colleague Conduct 301 as a "Critical Infraction", under "Falsification of organizational records, or providing false or misleading information."

If the colleague has lost their ID badge, or it has been damaged through other than normal usage, a replacement can be obtained by first paying a replacement fee to the nearest Sentara cashier and presenting the receipt at the nearest badge replacement location. Please contact your Security office for replacement badge information.

Upholding the Policy

Our policies are here to guide and support and ensure safety in the workplace rather than dictate. While we've provided broad guidelines, we trust in your judgment and understanding of Sentara's values. We are all stewards of Sentara's reputation, and our leaders are here to help ensure we reflect our best self and therefore have the responsibility to ensure if someone misunderstands or isn't in adherence with this policy, they clarify and take the best course of action for correction.

We're always here to understand and accommodate special needs based on medical or religious grounds. Feel free to discuss these with your supervisor, Employee Relations, or other system advisors such as Infection Prevention and Control and/or Employee Health.

Based on the diversity of our business needs, senior leaders and human resources, in collaboration, may publish additional dress code expectations.

Exceptions:

None.

Monitoring:

Outcomes Monitoring – Departmental Directors/leaders shall be responsible for monitoring and ensuring adherence and enforcement of the stated Dress Code requirements.

Document Management – Human Resources shall be responsible for developing, communicating, and maintaining this policy and related procedures and job aids necessary for the implementation and continuance of the policy. This policy shall be reviewed at least every 3 years for repeal or amendment as appropriate.

Related Documents:

Policy	Colleague Conduct 301
Procedure	IP&C Hand and Fingernail Hygiene Procedure 204 Surgical Attire in the Surgical Area Infection Prevention & Control Isolation
Job Aids	Sentara Colleague Handbook
Regulatory References	DNV Managing Infection Risks Standards

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Policy:	Drug and Alcohol-Free Workplace 303		
Manual:	Human Resources	**Original Date:**	05/01/2024
Section:	Employment	**Revision Date:**	7/16/2024
Location(s):	Sentara Health and its direct and indirect wholly-owned and/or majority-owned subsidiaries, including SAMC, SCH, SHRH, SLH, SMJH, SNGH, SNVMC, SOH, SPAH, SRMH, SVBGH, SWRMC	**Approved By:**	Executive Vice President & Chief People Officer
		Process Owner:	Human Resources

Revision Description (Most Recent): Combined Substance Abuse Testing Policy

Policy Statement

At Sentara Health, we value the well-being of our colleagues, patients, and members. We are dedicated to maintaining a safe, healthy, and efficient work environment, free from the influence of drugs and alcohol. This is crucial for the impeccable service we deliver and fundamental to preserving Sentara's reputation and the confidence of the communities we serve.

As an essential part of our team, you play a vital role in ensuring this environment. You should refrain from the unlawful use, possession, sale, or transfer of illegal drugs or controlled substances, including but not limited to alcohol and marijuana, in any manner that may impair your ability to perform assigned duties or adversely impact Sentara's business.

You must report any legally prescribed drugs you take at work, which may influence your work performance, to Employee Health. Please discuss with your healthcare provider if a prescribed drug could affect your work performance and obtain a medical release, if necessary, before returning to work.

This policy applies to all team members, including applicants, colleagues, students in Sentara schools, contractors, and other service providers associated with Sentara.

Seeking Help

If you or a family member are dealing with addiction, we want you to know that we care, and help is available. We highly encourage colleagues and their family members to utilize our Employee Assistance Program (EAP), a valuable resource that offers professional services designed to support mental and physical well-being. We believe that reaching out for help is a sign of strength, and we stand with you in your journey towards recovery.

We are committed to creating a supportive, safe, and respectful environment where colleagues can thrive both personally and professionally.

Prohibited Activities

The following are violations of the Drug-Free Workplace policy and may result in disciplinary action up to and including termination:

- Using, selling, purchasing, transferring, possessing, manufacturing, or storing an illegal drug, drug paraphernalia, or controlled substance, including the improper use of a prescribed substance, while in the course of employment or while engaged in a Sentara-sponsored activity. This applies whether on Sentara premises, in Sentara-owned, leased, or rented vehicles, on Sentara business, or off the job if the activity adversely affects Sentara's operations or reputation.
- Attempting or assisting another individual to engage in the activities listed above.
- Working or reporting to work under the influence of an illegal drug or controlled substance, including alcohol, marijuana, or improper usage of a prescribed drug.
- Switching, adulterating, or tampering with any sample submitted for testing or interfering with the testing process.
- Failing to report for a drug test at a Sentara designated collection site or when directed.
- Being charged or convicted under any criminal drug statute under circumstances that Sentara determines adversely impacts Sentara's operations or reputation.

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Notification of Charges and Convictions

If you are charged or convicted under any criminal drug statute related to drugs or alcohol, including DUI, you must notify your manager within five (5) days. Your manager will then report this information to Human Resources.

Substance Abuse Testing Program

Applicants and Students

Drug/alcohol screenings of all applicants to whom an employment offer or an offer of enrollment to the Sentara College of Health Professions has been made will be conducted before the applicant's hiring or student's enrollment is final. Students who are assigned to Sentara facilities for clinical training will be subject to their school's pre-enrollment drug screening policies.

If an individual refuses or is ruled out for employment or Sentara College enrollment due to unacceptable positive results, he/she may not reapply for a period of 12 months from the date of the test.

Reasonable Suspicion

When there is reasonable suspicion that an individual may be under the influence of drugs or alcohol, first-hand observation should be made immediately by more than one (when possible) supervisor or manager. Reasonable suspicion can include:

- Observation of inappropriate behavior (i.e., slurred speech, poor coordination, irrational behavior, hyperactivity, etc.) or performance and/or other problems on the job that may be caused by substance abuse.
- Credible information on illegal drug activity from a reliable source.
- On-the-job accident or serious incident resulting in property damage or personal injury or where the supervisor has reason to question your physical, mental, and/or emotional condition.
- Instances where you are suspected to be associated with missing controlled substances or where illegal drugs are found in your possession or in or on your personal property brought onto Sentara premises or otherwise while at work. Testing may include groups of colleagues as determined by the circumstances.

Sentara reserves the right to remove any non-employee (i.e., contractor, traveler) who is suspected of being under the influence of a drug or alcohol from their duties. The testing procedure will be determined by the non-employee's employer or contract terms.

Substance Abuse Testing Procedures

When testing is required, the colleague will be directed to report at a designated time and place. Appropriate collection and chain of custody procedures will be followed to protect the integrity and accuracy of the test and to respect your dignity. Refusal of the test, or failure to produce the required specimen within three hours of notification will be grounds for termination of employment.

Positive test results will be referred to a Medical Review Officer (MRO). To protect confidentiality, the MRO will communicate the results, as well as any attempt to tamper with a specimen, to the appropriate Employee Relations Representative. The colleague is not permitted to return to work until authorized by the manager/supervisor and/or the appropriate Employee Relations Representative.

Positions Subject to DOT Regulations

The following screenings may be required if you hold a position that requires the operation of vehicles covered by the Department of Transportation (DOT):

- pre-employment;
- random screening;
- periodic testing; and
- post-accident testing

Search

Sentara reserves the right to conduct reasonable searches of individuals, personal effects, lockers, or vehicles when entering, present on, or leaving company premises. The purpose of these searches is to deter the use, possession, transportation, or sale of illegal drugs and alcoholic beverages and maintain a safe work environment. Consent to such

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searches is required as a condition of employment, and refusal may result in disciplinary action, up to and including termination.

Required Reporting

Managers or designated leaders are required to report any relevant information to the applicable licensure board, governing authority or entity, and Human Resources.

Exceptions

None

Monitoring

Outcomes Monitoring – Leadership and Human Resources shall be responsible for monitoring and ensuring adherence to this policy.

Document Management – Employee Relations shall be responsible for developing, communicating and maintaining this policy and related procedures and job aids necessary for the implementation and continuance of the policy. This policy shall be reviewed at least every three years for repeal or amendment as appropriate.

Related Documents

Policy	301 Colleague Conduct Policy 303b Employee Assistance Program
Procedure	List Procedures.
Job Aids	List Related Job Aids.
Regulatory References	List Regulatory References.

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Section 9

School of Medical Laboratory Science

Harrisonburg, Virginia

Academic Policies

(Reviewd 4/24/2026)

Policies on Grading and Academics

The grading system will consist of the following:

90-100 A
80-89 B
70-79 C
Below 70 = unacceptable grade

A minimum of 70% must be maintained in all courses. Below 70% is unacceptable performance.

All tests must be taken on the assigned day or a failing grade is recorded. Exceptions may be made in emergency situations.

If a student fails (below 70%) on two didactic tests, he/she may be put on probation. If a third didactic test is below 70%, the student may be dismissed from the program. Three or more quizzes below 70% may result in the placement of the student on probation. Once on probation, the failure of two additional quizzes may result in dismissal of the student. All probation status will remain in effect for the entire duration of the course, upon successful completion of the course probation may be lifted.

The progress of each student will be communicated to them by posting grades weekly on Canvas.

Honor Code Violations

The Program has a zero tolerance for cheating. If a student is found to be breaking the honor code they will be dismissed from the program. If faculty suspect that a student is cheating, the incident will be reported to the Program Director who will investigate and then convene a meeting of the Advisory Committee. At this meeting the Program Director will give a report of the incident and the committee will help determine an appropriate disciplinary response. The student may be asked to provide a written statement prior to the meeting.

Certificate of Completion

The Program awards a certificate upon successful completion of all course requirements. ***The granting of the certificate is not contingent upon the student's passing any type of external certification or licensing examination***. In addition, an official grade transcript is provided to the student. For 3+1 students, grade transcripts will be forwarded to their university or college. It is recommended that students receive a total of 30+ semester credit hours for their year of attendance by their respective university. Each credit hour correlates approximately to 8 clock hours for lecture. Each credit hour correlates approximately to 32.5 clock hours for the practicum portion.

Transcripts of grades include the following:

Course	Grade	Suggested Semester Hours
MT 403 Clinical Chemistry		4
MT 503 Clinical Chemistry Practicum		6
MT 400 Clinical Hematology (Includes Hemostasis)		4
MT 500 Clinical Hematology Practicum		5
MT 402 Immunohematology (Blood Bank)		2
MT 502 Immunohematology Practicum		4
MT 405 Microbiology		4
MT 505 Microbiology Practicum		6
MT 412 & 506 Computer Science and Laboratory Skills		2
MT 410 Orientation (Safety and Quality Assurance)		1
MT 401 Clinical Immunology		2
MT 404 Urinalysis and Body Fluids		1
MT 408 Clinical Laboratory Supervision and Management		1
MT 409 Education and Research Methods and Design		1

Sentara RMH School of Medical Laboratory Science

Course Descriptions

MT 403 and 503–CLINICAL CHEMISTRY
Didactic—Lecture instruction includes pre-analytical, analytical, and post-analytical components as well as the principles of all tests performed in clinical chemistry; the pathophysiology and anatomy involved in interpretation of test results; quality control; statistics and their evaluation; and laboratory mathematics. Topics include liver function, carbohydrates, lipids and apolipoproteins, proteins, enzymes, acid-base balance, therapeutic drug monitoring, toxicology, endocrinology, molecular diagnostics, tumor markers, vitamins and analysis of all body fluids. ***Four credit hours*.**

Practicum—Laboratory instruction is given on all current clinical chemistry methods using instrumentation along with interpretation of laboratory results. Physical, chemical, and microscopic analyses of the urine are included, as well as special testing procedures, quality control and computer operation. ***Six credit hours*.**

MT 400 and 500–CLINICAL HEMATOLOGY (Includes Hemostasis)
Didactic—Lecture instruction covers concepts of blood cell development, abnormal blood cell morphology in all types of hematologic disease, and the principles, quality control, and sources of error of all routine and specialized hematology tests/procedures. The principles and sources of error of current hematology instruments are included. Normal blood coagulation mechanisms of the body, the pathophysiology of hemorrhagic and thrombotic diseases, and the principles, techniques, and sources of error of tests performed in coagulation are also a part of this course. ***Four credit hours*.**

Practicum—Laboratory instruction on blood cell identification and differential counting in blood and body fluids, automated cell counting methods, and all other hematologic methods to include specialized tests. Laboratory instruction on the performance and quality control of routine and specialized tests in coagulation. Emphasis is placed on the correlation of test results with disease states. In addition, laboratory instruction on immunology/serology testing is included. ***Five credit hours*.**

MT 402 and 502–IMMUNOHEMATOLOGY (Blood Bank)
Didactic—Lecture covers principles of blood banking, including all the major blood group systems, antibody characteristics and problems, use of blood components, donor screening, transfusion reactions, prenatal testing and genetics. ***Two credit hours***.

Practicum—Laboratory instruction on blood typing and cross-matching procedures, antibody identification, blood component preparation, blood donor requirements and draws, quality control procedures and problem-solving in blood bank. ***Four credit hours.***

MT 405 and 505–MICROBIOLOGY

Didactic—Lecture includes bacteriology, parasitology, virology and mycology. Instruction includes principles of identification of pathogenic organisms and principles of microbial pathophysiology, including colony morphology, biochemical characteristics and staining characteristics. Also included is the theory of antibiotic treatment and testing, media characteristics, sterilization methods, and bacterial, parasitic, virus, and fungus growth requirements. ***Four credit hours*.**

Practicum—Laboratory instruction on bacterial, mycobacterial, fungal and parasitic isolation, identification and susceptibility testing, including plate reading, biochemical inoculation and reading, and gram and acid-fast staining. Media preparation instrumentation and quality control in microbiology are also emphasized. ***Six credit hours*.**

MT 412 & 506–COMPUTER SCIENCE AND LABORATORY SKILLS

Didactic—Lecture includes the principles of computer science, phlebotomy, specimen handling procedures, customer relations and problem solving. One credit hour. Practicum—Laboratory instruction on computer systems; proper techniques in collection, handling and processing specimens; practice in problem-solving skills. ***One credit hour.***

MT 410—ORIENTATION (Safety and Quality Assurance)

Didactic—Lecture includes a review of ethics and professionalism, statistics, quality assurance in the clinical laboratory, and statistical approaches to data evaluation. Safety in the hospital/ laboratory is also included. ***One credit hour*.**

MT 401—CLINICAL IMMUNOLOGY

Didactic—Lecture instruction on principles of immunology, emphasizing the clinical aspects of immunology such as hypersensitivity, autoimmune disease and immune deficiency states. Principles and sources of error of all types of clinical serologic tests/procedures are also covered. ***Two credit hours*.**

MT 404—URINALYSIS AND BODY FLUIDS

Didactic—Lecture instruction on the structure and function of the kidney, renal pathology and the principles, sources of error and interpretation of test results in urinalysis. Lecture instruction on all body fluids, testing, sources and test interpretation is also given. ***One credit hour*.**

MT 408—CLINICAL LABORATORY SUPERVISION AND MANAGEMENT

Didactic—Lecture instruction on performance improvement, critical pathways, human resource management, financial management, management styles, team building skills, dynamics of health care and laboratory, communications, ethics, selection of lab computer systems and government regulations and standards. ***One credit hour*.**

MT 409—EDUCATION and Research Methods and Design

Didactic—Lecture instruction on writing behavioral objectives; teaching methods; forms of evaluation and motivation of students; research design; and basic principles of evaluating a research paper. ***One credit hour*.**

Sentara®

SRMH School of Medical Laboratory Science

Admissions Policy

(Revised 6/23/2026)

Applicants must complete the following from an accredited institution of higher learning:

- Students must either have a bachelor's degree from a regionally accredited college/university or be guaranteed one upon the completion of the clinical year.
- 16 semester hours (24 quarter hours) of biology, to include microbiology
- 16 semester hours (24 quarter hours) of chemistry to include organic chemistry or biochemistry
- One college level mathematics class
- Immunology, Genetics, statistics and computer courses are highly recommended
- A minimum grade point average in science courses of 2.6 on a 4.0 scale
- Submit an official college/university transcript. All prerequisite course work must be completed prior to admission to the program.
- Applicants who have met the minimum academic requirements more than seven years prior to application will be required to update by taking one course in chemistry and one course in biology

Admission criteria include a personal interview, analysis of college transcripts, and review of three letters of recommendation. Priority will be given to applicants enrolled at the academic affiliates and residents of the State of Virginia. In addition, essential functions are required for admission. Students will be notified of admission by letter.

Applicants must meet one of the following requirements

- Has received a baccalaureate degree from a regionally accredited United States college/university, or
- Is enrolled in an academic affiliate and will receive a bachelor's degree upon completion of the SRMH MLS program
- Has received a baccalaureate degree from a Canadian university accredited by an association acceptable to ASCP, or
- Has received a degrees from a colleges/university outside of the United States and Canada which has been evaluated by a foreign transcript evaluation agency acceptable to ASCP, to be substantially equivalent to the above

Regional Accreditation Agencies

- MSA – Middle States Association of Colleges and Schools
- NWCCU – Northwest Commission on Colleges and Universities
- NCA-HLC – North Central Association of Colleges and Schools
- NEASC-CIHE – New England Association of Schools and Colleges, Inc.
- SACS/CC – Southern Association of Colleges and Schools/Commission on Colleges
- WASC-ACCJR – Western Association of Schools and Colleges

NOTE: We will prepare you for the lab portion of the ASCP exam or any certification exam. We cannot change the non-lab (experience and/or undergraduate accreditation) requirement for any certification exam. We cannot guarantee that you will be able to sit for any exam.

Students are admitted twice a year for classes beginning in January and June.

The program does not offer advance placement of credits for experiential learning.

Academic Affiliations

The Sentara RMH School of Medical Laboratory Science is affiliated with:

- Bridgewater College, Bridgewater, VA
- Eastern Mennonite University, Harrisonburg, VA
- George Mason University, Fairfax, VA
- Miami University of Ohio, Oxford, OH
- Mary Baldwin University, Staunton, VA

Clinical Affiliations

The Sentara RMH School of Medical Laboratory Science is affiliated with Sentara Healthcare for student rotations within Sentara's Consolidated Laboratory Services at the following hospitals:

- Sentara Rockingham Memorial Hospital
- Sentara Martha Jefferson Hospital
- Sentara Northern Virginia Medical Center
- Sentara Obici Hospital
- Sentara Norfolk General Hospital

Fair Practices in Education

Sentara seeks to select qualified applicants without regard to race, color, religion, age, sex, marital status, gender identity and expression, sexual orientation, pregnancy, childbirth or related medical conditions, including lactation, military status, genetic information, national origin, disability, or any other legally protected status, providing the applicant is qualified to perform the essential functions of the job with or without reasonable accommodation.

Sentara RMH School of Medical Laboratory Science

(Reviewed 4/24/2026)

Transfer Credit

The school does not give credit for work completed at other institutions. Credits earned at the school are transferable to another institution at the sole discretion of the accepting institution.

Sentara RMH School of Medical Laboratory Science

Refund Policy

(Revised 4/24/2026)

If a student withdraws from the program, a refund may be requested. Notice of withdrawal should be submitted in writing to the Program Director of the School of Medical Laboratory Science. (This refund policy applies to the $100 deposit and $5,000 tuition).

The refund policy is as follows:

A. A student who enters the school but withdraws or is terminated during the first quartile (25%) of the program shall be entitled to a minimum refund amounting to 75% of the cost of the program.
B. A student who withdraws or is terminated during the second quartile (more than 25%, but less than 50%) of the program shall be entitled to a minimum refund amounting to 50% of the cost of the program
C. A student who withdraws or is terminated during the third quartile (more than 50%, but less than 75%) of the program shall be entitled to a minimum refund amounting to 25% of the cost of the program.
D. A student who withdraws after completing more than three quartiles (75%) of the program shall not be entitled to a refund.

A student applicant may cancel by written notice, their enrollment at any time prior to the first class day of the session for which application was made. When cancellation is requested under these circumstances, the school will refund all tuition paid by student, less a maximum tuition fee of $100.00. A student applicant will be considered a student the first day of class.

Sentara RMH School of Medical Laboratory Science

Harrisonburg, Virginia

Attendance & Late Policy

(Reviewed 4/24/2026)



Late is defined as being one minute past the time that class or rotation begins. For example, if a rotation begins at 8:00 AM, 8:01 is defined as late.

Five or more days late per didactic portion or rotation will be considered tardiness and may be reason to put a student on probation. Seven or more days late per didactic portion or rotation is unacceptable, and may be cause for dismissal. If you will be 5 minutes late, you must call the school. Extenuating circumstances such as emergencies or car trouble will be evaluated on a case-by-case basis.

Students will be considered withdrawn from the program after missing 14 calendar days in a row (including weekends & holidays) after the student's last date of attendance.

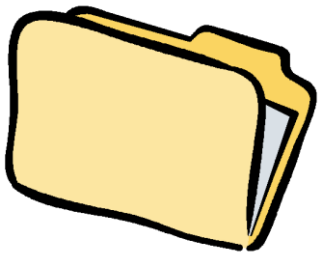
Make-up work due to absences during the didactic portion of the program: it is the student's responsibility to obtain lecture notes from another student.

Students who have unsatisfactory attendance may be dismissed from the program. A student dismissed because of unsatisfactory attendance will not be readmitted to the program.

Sentara RMH School of Medical Laboratory Science

Student Records

(Reviewed 6/18/2026)



All student records will be maintained permanently.

To ensure confidentiality is maintained, physical copies of student records are kept in locked offices and filing cabinets within the school. Electronic copies of student records are maintained on Sentara Health's secured IT network. Only faculty and staff of the School of Medical Laboratory Science may access student records, both physical and electronic.

A student may obtain his/her student records and/or financial records by written request with signature. Records of grades and/or financial history will not be released to anyone without written request from student with signature.

Sentara RMH School of Medical Laboratory Science

STUDENT EMPLOYMENT AND SERVICE WORK POLICY

(Reviewed 4/24/2026)



Understanding that employment during the clinical year is sometimes a necessity, such employment is left up to the discretion of the individual student. When considering this option, the student should remember that the clinical program is a minimum of 40 hours each week, not including preparation and study time outside of the clinical setting. While outside employment is a student decision, the Program Director may counsel the student should academic work begin to decline.

Following completion of the first clinical rotation, students may be eligible to apply to work weekends, evenings or holidays according to hospital employment policies, based on position availability. This employment is an option to the student, and compensation will be monetary. When students work for pay, they are responsible to the hospital, as any other employee, and this work has no connection to the requirements of the student by the School of Medical Laboratory Science. Again, work is contingent upon position availability within the laboratory, and will be handled by the School of Medical Laboratory Science as any other form of employment would be handled.

Service work by students in clinical settings outside of academic hours must be noncompulsory.

Students may not be substituted for regular staff during their student experiences.
Students may perform patient testing only the direct supervision under qualified laboratory personal. Students may not report patient results.

Sentara RMH School of Medical Laboratory Science

COMPETENCY STATEMENTS*

(Reviewed 4/24/2026)

The following competencies are for all the areas of the laboratory to include chemistry, hematology (includes coagulation), microbiology (parasitology, mycology and virology), blood bank, immunology, body fluids etc. Measurement of all competencies is the minimum of 70% on all evaluation mechanisms to include written tests, laboratory practicals, oral exams, student lab worksheets and rotation evaluations.

The Sentara RMH Graduate Medical Laboratory Scientist:

APPLIES KNOWLEDGE OF THEORY AND PRINCIPLES RELATED TO:

1. Anatomy (body fluids)
2. Biochemistry (Chemistry and Hematology)
3. Genetics, Molecular Biology, Molecular Diagnostics, and Microbiology (Parasitology, Mycology and Virology)
4. Growth characteristics/diagnostic and infective forms (microbiology)
5. Immunology, Immunohematology, Education
6. Physiology (Body fluids, Chemistry, Hematology, Immunology) and Hematology (includes coagulation)
7. Fundamental biological characteristics related to laboratory testing and medical terminology
8. Principles of performing basic and special laboratory procedures
9. Theory and practice related to laboratory operations, management, safety, research design to include practice, and education techniques.
10. Standard operating procedures and Laboratory Information Systems
11. Sources of error in laboratory testing
12. Data security/patient confidentiality and theory and practice related to laboratory operations (management/safety/education/R&D)

SELECTS APPROPRIATE:

13. Type of sample and method for test requested
14. Reagents/ media/ blood products
15. Controls for test performed and course of action
16. Instruments to perform requested test and quality control procedures
17. Routine/special procedures to verify test results
18. Instruments for new laboratory procedures

PREPARES / PROCESSES:

19. Specimens
20. Reagents/ media/ blood products
21. Controls
22. Equipment and instruments

23. **CALCULATES RESULTS:**

ASSESSES TEST RESULTS BY CORRELATING LABORATORY DATA WITH:

24. Quality control data
25. Clinical or other laboratory data
26. Results obtained by alternate methodologies
27. Physiologic processes to validate test results and procedures

EVALUATES LABORATORY DATA TO:

28. Recognize related disease states
29. Make identifications
30. Resolve possible inconsistent results/sources of errors
31. Check for procedural/technical problems
32. Determine appropriate instrument adjustments
33. Take corrective action
34. Assess test for procedural validity/accuracy
35. Recognize and report abnormal test results and/or the need for additional testing
36. Determine alternate test methods
37. Establish new laboratory operational/testing procedures
38. Establish reference range criteria
39. Establish new testing procedures for alternate methods
40. Assure personnel safety

DEMONSTRATES BEHAVIOR APPROPRIATE FOR A CLINICAL LABORATORY SCIENTIST WITH REGARD TO:

41. Ethics and professional integrity
42. HIPPA regulations and patients
43. Professionalism
44. Continued professional career growth, development and maintenance
45. Laboratory safety

EVALUATES:

46. appropriate actions and methods
47. corrective actions
48. patient-related requirements
49. possible sources of error or inconsistencies
50. quality control procedures
51. specimen-related requirements

*Original from ASCP, Medical Technologist Competencies

Section 10

Sentara RMH School of Medical Laboratory Science

Students' Rights and Privileges

(Reviewed 4/24/2026)

1. **Counseling:** Confidential counseling assistance is available to students experiencing any personal problems. The Program staff will provide more information if requested. Confidentiality is maintained during all student-counseling sessions.

   There is an open-door policy with the program director and the education program coordinator. Students may seek advice or counseling at any time throughout the year.

   One formal counseling session with the program director and the education program coordinator will be scheduled. Additional formal sessions will be held if the student is experiencing problems.

   If a student has concerns/problems within the didactic phase of the Program, the student should first discuss the matter with the respective instructor. If not satisfied with the response, the student may then contact the Program Director for further discussion.

   After each rotation, the student will receive an evaluation completed by the department. This is an additional opportunity for the student to receive counseling when this evaluation is discussed between the Program Director and the student.

   During the clinical rotation portion of the program, the program director and education coordinator will contact the student regarding career planning. Students will be advised on how to write a resume and will be given information regarding job openings both within Sentara labs and at other healthcare facilities.

2. **Complaints:** Student complaints should be brought to the Program Director. If the complaint cannot be solved by the Program Director and the student, and it involves the entire class, then a class meeting will be held. The group will discuss the complaint and decide on a resolution that is acceptable to all concerned. Complaints will be addressed in a timely manner so that a resolution may be reached quickly with the satisfaction of everyone. Complaints will be handled within the framework of the Program and hospital policies. Respect for all involved is of utmost importance to the Program. If another department in the hospital is involved, the Program Director will contact the other department. It is felt that open communication will help to prevent any unhappiness from escalating into a complaint. Students will not be subject to unfair actions from the faculty in response to complaints.

3. **Respect:** Students have the right to respect from the Program Director, all instructors and fellow students.

4. **Leave of absence:** It is recognized that interruptions may occur for various acceptable reasons, such as an accident, illness, or pregnancy. Each request for interruption of the program will be considered on an individual basis. When a subject has been completed in its entirety, including both lecture and clinical rotation, credit will not be lost by interruption of the program. Partial credit would be given if at least three months of the program had been completed. Re-entrance for such interrupted training is dependent on space availability, academic standing at the time of the interruption, and length of interruption interval. Interrupted training must be reinstated within a two-year period.

5. **Voluntary Withdrawal:** A student may withdraw from the Program at any time.

6. **Safety:** Student safety is of the utmost concern for the hospital and school, and precautions to protect that safety will be maintained. Safety policies required by CAP and DNV and other accrediting agencies will be followed by the hospital and school.

7. **Laboratory work during clinical rotation:** Students may not be substituted for regular staff during their student experiences.

8. **Library Use:** The SRMH Library will provide up to 10 free interlibrary loan photocopies for students who are enrolled in the Program. Thereafter, an $8.00 charge will be assessed per article. Students may check out books from the library.

Student Responsibilities: The student will demonstrate the following affective, professional and ethical behavior:

1. Demonstrate an effort to achieve professional excellence by showing initiative to do extra tasks and show a willingness to complete unsolicited tasks.

2. Prepare for daily class assignments in an organized fashion and participate in class discussions (volunteers in class to answer questions and actively discuss class issues). Lack of preparation for class may be demonstrated in failing quiz grades.

3. Accepts and acts on advice from instructors

4. Does not argue with the instructor or solicit other students to argue with the instructor.

5. Assumes responsibility for behavior by following rules and policies. For example, follows the dress code and rules of the classroom.

6. Displays confidence, yet recognizes limitations of being a student.

7. Acts in a professional manner and maintains patient confidentiality according to HIPPA rules.

8. Works well in the School of Medical Laboratory Science as a team member with the other students and instructors. Contributes to the initiatives at hand in a positive manner.

9. Demonstrates respect to fellow students as well as instructors.

10. Reports to class on time and is present on all days as assigned.

11. Demonstrates hospitality standards of the profession and hospital to all students and instructors. Shows courtesy to other students and instructors similar to the hospitality they would show a guest in their home.

Section 11

Sentara RMH School of Medical Laboratory Science

Library Resources

Sentara RMH Virginia Funkhouser Library / Sentara RMH Medical Center
(shared space with Volunteer Services)
2010 Health Campus Drive
Harrisonburg, VA 22801

540-689-1777 phone
500-689-1770 fax
RMH_RMHLibrary@sentara.com
8:00AM – 4:30PM Monday – Friday

1 FTE professional staff: **Megan D. Khamphavong, MSLS**
Librarian
13 years post-degree professional experience in health sciences libraries; at Sentara RMH since 2007

Facility:
1,400 sq. ft.
Opened in May 2010
7 study carrels (all with PCs)
1 network photocopier / fax / printer / scanner
3 study tables with chairs

Collections & Services:
Access to library resources available via the following link:
https://www.skor.stacksdiscovery.com

4,300+ titles in print, searchable via a web-based catalog

- ~2,600 are clinical and consumer health, including 22 anatomic models
- ~1,000 in Leadership, management, business administration, medical staff & governance; training & development
- ~400 historical medical/nursing books
- ~300 in Grief

12,000+ electronic publications (books/journals) related to health/medicine

- with subject specific titles that include the following areas related to clinical laboratory science:
    - anatomy
    - cytology
    - histocytochemistry
    - laboratory techniques and procedures
    - microbiology
    - microscopy
    - mycology
    - parasitology

- pathology
- physiology
- virology

Research and reference databases, plus specialty search tools available through the EBSCO Discovery Service.

- Research and reference databases
  - APA PsycEXTRA
  - Atla Religion Database with AtlaSerials PLUS
  - Biomedical Reference Collection: Comprehensive
  - Business Source Elite
  - CINAHL Complete
  - Cochrane Collection Plus
  - eBook Collections
  - Education Source
  - ERIC
  - GreenFile
  - Health Business Elite
  - Library, Information Science & Technology Abstracts (LISTA)
  - MEDLINE Complete
  - Nursing and Allied Health Collection: Comprehensive
  - OpenDissertations
  - Psychology and Behavioral Sciences Collection
  - Regional Business News
  - SocINDEX

- Specialty resources
  - Access Medicine (Cardiology, Emergency Medicine, Surgery)
  - AORN eGuidelines+
  - Bates' Visual Guide to Physical Examination
  - Current Opinion Journal Series
  - DSM: Diagnostic and Statistical Manual of Mental Disorders
  - DynaMedex/DynaMed Decisions
  - Dynamic Health
  - Infusion Nurses Society
  - JCO Digital Library
  - Joanna Briggs Institute
  - UpToDate Lexidrug
  - Merative Micromedex
  - New England Journal of Medicine Journal Collection
  - Scientific & Medical ART Imagebase (SMART)
  - Visible Body Human Anatomy Atlas

Consolidated acquisitions for information resources across departments within Sentara RMH Medical Center and the Medical Group

Interlibrary loan and article copy services, including

- membership and participation in the National Network of Libraries of Medicine

Mediated literature searching and individual, as well as group training offered in search techniques

Section 12

Sentara

Medical Laboratory Scientist

MT 410 Orientation----Objectives

Upon completion of the orientation lectures and reading assignments, the MLS student will: (measurement will be the attainment of a minimum of 70% on a written exam)

1. Recognize and define panic values. Describe the appropriate course of action when panic values are found in the lab. Explain why a QC program is necessary in a lab.

2. Utilize in method validation the following terms: calibration, accuracy, precision, sensitivity, specificity, reportable range, and reference intervals.

3. Set up a quality control program for a laboratory to include the following tasks:

- **Calculation of standard deviation**
- **Assign ranges for the controls**
- **Draw Levey Jennings Charts**
- **Interpret Levey Jennings charts containing upward and downward trends and shifts**
- **Identify results that do not meet the Westgard Multirules**
- **Devise a successful plan to correct any QC problems**

4. Interpret the daily plotted control values on a Levey Jennings Chart.

5. Draw a normal Gaussian Curve and assign percent values to plus and minus one, two, and three standard deviations from the mean.

6. Evaluate different laboratory methods by utilizing the coefficient of variation calculation. Select the best method from the calculation results. Correlate the meaning of coefficient of variation and reproducibility of a method.

7. Interpret the National Fire Hazard Labels.

8. Define the different classes of fires and what fire extinguisher to use. Use the fire extinguishers in the correct manner.

9. Recognize and respond to all the hospital codes such as code pink etc.

10. Define the meaning of RACE with regard to a fire.

11. Demonstrate Standard Precautions techniques at all times. Describe why Standard Precautions are utilized in the laboratory. Identify what organization requires the use of Standard Precautions.

12. Utilize Bomb Threat Cards and identify where they are found in a department.

13. Define the "Right to Know" Law and how it affects the laboratory and the employee.

14. Identify where "Spill Kits" are found in the laboratory and the school and use these kits if necessary.

15. Define and use Delta checks.

16. Demonstrate the proper hand washing technique.

17. Explain CLIA of 1988 to include personnel in the lab and meaning of "CLIA."

18. Define the differences between plasma and serum.

19. Define the various organizations discussed in class that influence the clinical laboratory to include ASCP, JCAHO, and CAP.

20. Discuss the changes that have occurred in the clinical laboratory over the years.

21. Adapt a professional attitude to include the protection of the patient's confidentiality.

22. Utilize statistical approaches to data evaluation.

23. Utilize the safety features in the laboratory and school to include the following:

- **MSDS sheets**
- **spill kits and hazard identification labels**
- **protective equipment**

- **different types of fire extinguishers**
- **standard precautions**
- **bomb threat cards**
- **chemical exposure directions**
- **safety maps of the laboratory.**

24. Define the variables of lab testing as they are categorized according to the following terms:
- **Pre-analytical**
- **Analytical**
- **Post-analytical**

25. Demonstrate a professional behavior while applying HIPPA rules and guidelines regarding patient confidentiality.

26. Defend a professional attitude by practicing personal career development, ethics, and general characteristics of a clinical laboratory scientist professional.

27. Explain the Six Sigma Process.

28. List the sections that must be included in a laboratory procedure according to the CLSI, Clinical Laboratory Standards Institute.

29. Identify pre-analytical variables of laboratory testing as addressed in Tietz.

30. Define ethics.

31. Demonstrate ethical behavior.

32. Define professionalism.

33. Correlate professionalism and HTL & MLS.

34. Describe the certification maintenance program from ASCP.

35. Calculate problems for molarity and normality.

36. Perform serial dilutions and calculate the final dilution.

37. Solve problems that may occur in making math calculations in the clinical laboratory, and when making up reagent solutions.

38. Make dilutions in the clinical laboratory.

39. Identify and solve problems in making dilutions in the clinical lab.

40. Convert mg% to mEq/L and mEq/L to mg% for analytes. Identify and correct problems that may occur in these calculations.

41. Identify basic blood cells to include monocyte, lymphocyte, segmented neutrophil, and the platelet (which is not a cell.)

42. Identify the normally largest cell seen in a peripheral blood smear.

43. Describe the function of the platelet seen in a peripheral blood smear.

44. Define the following to include formula if applicable:

- **Analytical sensitivity**
- **ASCP**
- **JCAHO**
- **CLSI**
- **Youden Plot**
- **Predictive value of positive (PV) –calculate the value for a test**
- **The pH –interpret pH value and assign as basic, acid, or neutral**
- **Buffer**

45. Define ergonomics in an organization and explain why this is necessary in the laboratory.

46. Calculate and perform Metric conversions.

47. Define and discuss buffer and buffer systems.

48. Discuss and define pH and correlate pH values with acid, neutral and basic.

Following completion of computer training, the student should be able to:

1. List the steps involved in the selection and acquisition of laboratory information systems. (This objective will be addressed in the management class.)

2. Explain and use appropriately the computer systems found in the current clinical laboratory. Discuss computer science and principles of computers including start-up procedure and Internet use and access.

3. Explain, use, and trouble-shoot the applications of desktop PC's to include the following: word processing, spreadsheets, databases, browsers, e-mail such as Outlook, rebooting procedures, and Windows.

4. Utilize Windows Excel, Power Point and word-processing programs.

Orientation Course—MLS

Orientation Grade; Professionalism, Ethics, and Affective Behavior—Counts ½ of Orientation Grade. To be averaged with the Orientation written exam at the completion of the didactic segment of the program.

Objectives

The student will be able to demonstrate the following affective, professional, and ethical behavior during the didactic portion of the program with a minimum of 70% on the following characteristics:

(student will be rated on the Professionalism grid and a grade will be calculated as per the grid)

1. Demonstrate an effort to achieve professional excellence by showing initiative to do extra tasks and show a willingness to complete unsolicited tasks.
2. Prepare for daily class assignments in an organized fashion and participate in class discussions (volunteers in class to answer questions and actively discuss class issues). Does not argue with the instructor or solicit other students to argue with the instructor. Lack of preparation for class may be demonstrated in failing quiz grades.
3. Accepts and acts on advice from instructors.
4. Assumes responsibility for behavior by following rules and policies. For example, follows the dress code and rules of the classroom.
5. Displays confidence, yet recognizes limitations of being a student.
6. Acts in a professional manner and maintains patient confidentiality according to HIPPA rules.
7. Works well in the MLS and HTL School as a team member with the other students and instructors. Contributes to the initiatives at hand in a positive manner.
8. Demonstrates respect to fellow students as well as instructors.
9. Reports to class on time and is present on all days as assigned.
10. Demonstrates hospitality standards of the profession and hospital to all students and instructors. Shows courtesy to other students and instructors similar to the hospitality you would show a guest in your home.

ProfessionalismObjectives

MT 410 Orientation



Instructor: Abigail L. Blosser, MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, question and answer

Goal: To educate the student in laboratory safety, professionalism, ethics, statistics, quality assurance, method validation and statistical approaches to data evaluation so that they may function as an entry level medical laboratory scientist or histotechnologist.

Textbook:

Fundamentals of Clinical Chemistry and Molecular Diagnostics, Tietz, edited by Burtis and Bruns, W.B. Saunders, 7th edition, 2015

Extensive handouts will be utilized in the class.

Pre-requisite Courses:

for MLS: 3 years of college with required science courses plus guarantee of BS degree upon completion of clinical year;

ORIENTATION LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
6/16/26	I. Evaluation of Methods, Method Selection, and Quality Control a. Calibration b. Accuracy and Precision c. Analytical Sensitivity and Clinical Sensitivity d. Analytical Specificity and Clinical Specificity e. Reportable Range/ Analytical Measurement Range f. Setting up a Control Range and Acceptable Range on a Control g. Levey-Jennings Charts i. Trends ii. Shifts iii. Normal Gaussian Curve h. Coefficient of Variation i. Quality Assurance Report i. Delta checks ii. External Quality Control j. Panic Values k. Lab Test Procedure l. Westgard Multirule Chart m. CLIA n. QC in Chemistry and Hematology o. Reference Intervals p. Laboratory Mathematics (Molarity etc.) q. Dilution Problems r. Predictive Value of Positive s. The pH Definition and Examples	Supplemental reading: Tietz: Chap. 2,3,5,6,7
6/18/26	II. Laboratory Safety a. MSDS Sheets b. Hand Washing c. Hazard Labels d. Classes of Fires and Fire Extinguishers e. Hazard Identification System f. Standard Precautions g. What to do in case of a fire h. Codes for the hospital i. Bomb Threat Cards j. General Safety Standards k. Central Safety Areas of Our Lab l. What to do in case of a Chemical Exposure m. Safety Maps for Our Laboratory	

DATE: TOPIC: READING ASSIGNMENT:

n. Ergonomics

III. Introduction to the Profession
   a. Personnel in the clinical laboratory
   b. Organizations that influence the Lab
      i. ASCP, CAP, JCAHO, CLIA 1988, AABB, OSHA, NAACLS, DNV (Det Norski Veritas Healthcare, Inc.
      ii. Federal Gov.
         1. Confidentiality and HIPAA Rules (Health Insurance Portability and Accountability Act of 1996.
   c. Changes in the profession over the years
   d. Principles and application
      i. Ethics—what does Ethics mean?
      ii. Professionalism
      iii. Ongoing Professional Career Development
   e. Human blood cells
      i. Monocyte
      ii. Platelet
      iii. Segmented Neutrophil
      iv. Lymphocyte
      v. Red blood cell
      vi. Sickle cell, eosinophil, basophil

IV. Pre-analytical, Analytical, and Post-analytical Components of Lab Testing
   a. Pre-analytical Components
      i. Specimen Collection
      ii. Other factors that affect the specimen prior to testing
   b. Analytical Components
      i. Testing factors
   c. Post-Analytical Components
      i. Reporting results –factors that affect the test after the test is run

ORIENTATION LECTURE SCHEDULE

DATE: TOPIC: READING ASSIGNMENT:

ii. Panic values

V. Patient Confidentiality
   a. HIPPA Rules and Guidelines

VI. Computer Training
   a. Log-on to wavenet/workday
   b. Information Services Policies
      i. Sentara (outlook) email
         1. Not secure – no inclusion of
         2. patient data/info should be included
         3. Awareness with all email
            a. Anything can and will be used against you
            b. Avoid suspicious style emails; chain emails
      ii. Anything performed on a Sentara PC is the property of Sentara
      iii. Accessing internal data – H:\ drive
   c. Navigate general features of wavenet:
      i. Outlook
         1. Finding people
         2. Added addresses
         3. Composing a signature line
      ii. Compliance 360
         1. Human resources policies and procedures
         2. Navigate to procedures and finding what you're looking for

ORIENTATION LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
	iii. MSDS online iv. Sentara audioconference 1. Telcom services a. Dial out (9), general access codes b. 877-466-2185 v. Sentara/Wavenet Directory 1. Employee look-up	
6/22/26	**Final Exam**	

Section 13

SRMH School of Medical Laboratory Science

MT 412 & 506 Computer Science and Laboratory Skills Objectives

(revised 6/29/2020)

The student will after the lectures, reading assignments, and verbal instructions with accuracy of 70% on a written or oral exam:

1. Explain and perform the procedures involved in the following:
    a. Identifying a patient before venipuncture is performed
    b. Performing a venipuncture
    c. Draw blood cultures
    d. Draw blood from patients with IV's, dialysis shunts, and mastectomies
    e. Heel stick on newborns
    f. Fingerstick
    g. Glucose tolerance test
    h. Lactose tolerance test

2. Given a specific collection tube, be able to identify the anticoagulant, if any, explain its use, its chemical make up, the action of the anticoagulant on the blood sample, the resulting product (whole blood, plasma or serum), the tests that this tube may be used to perform, and in which tests the anticoagulant may cause interference.

3. Given a specific patient, determine the proper method of collection (vacutainer, syringe, capillary puncture or butterfly) for that patient and label the specimen correctly.

4. Given a specific unsatisfactory blood collection (hemolyzed, short draw, etc.), determine if the sample can be used for the specified test, what complications may arise if the sample is used, and what can be done, if anything, to salvage the sample.

5. Given patient case studies (including possible difficult and unusual sticks), describe how to gain the patient's confidence, obtain the needed blood, present a professional appearance, and recognize when it is necessary to ask for assistance. Demonstrate good problem-solving skills in handling these difficult patients.

6. Given a specific laboratory incident, describe the standard precautions that apply to this situation, how to properly dispose of contaminated materials, report the incident, and seek medical treatment, if indicated. (Partially covered in orientation class.)

7. Identify the major blood vessels and tendons located in the antecubital area of the arm.

8. Explain the purpose of, and the procedure for, a bleeding time including expected results, interpretation of those results, and the cause of falsely elevated or decreased results.

9. Define and explain the use of a HEPA and N95 filter mask. (Covered in orientation class.)

10. Assess a difficult patient situation, devise a plan of action to handle this patient and collect the specimen.

LAB: Perform a satisfactory venipuncture using the "arm" and venipucture training aid for each collection method (vacutainer, syringe, butterfly) as observed by the Education Coordinator.

11. Given a specific list of tests required, determine the best method of collection, select the tubes, collect the specimen, and label the sample tubes, using good technique.

Computer Lecture

Following completion of computer training, the student should be able to:

12. List the steps involved in the selection and acquisition of laboratory information systems. (This objective will be addressed in the management class.)

13. Explain and use appropriately Sentara Healthcare's computer applications to include WaveNet and Microsoft Outlook email

Sentara RMH School of Medical Laboratory Science

MT 412 & MT 506- Computer Science and Laboratory Skills Course Outline



Instructor: Emileigh Conley, BS, MLS(ASCP)^{CM}

Method of Instruction: Demonstration, Lecture, Video, Practice

Study Guide: Handout for Basic Phlebotomy Techniques

Course Goal: To prepare the student to function as a beginning level technologist/scientist who is able to draw blood, utilize computer systems, and solve problems in the laboratory.

Pre-requisite Courses: 3 years of college with required science courses for entry into Sentara RMH School of Medical Laboratory Science plus guarantee of BS degree upon completion of clinical year

Instructions: Bring study guide to class every day.

10/16/26

I. Introduction to Phlebotomy
    A. Duties and responsibilities
    B. Safety and standard precautions
        a. Protecting yourself and the patient

10/20/26

    C. Tubes and Uses
    D. Order of draw

10/21/26

    E. Site selection

II. Venipuncture Procedures
    F. Procedure for Venipuncture (Videos)
        a. Vacutainer
        b. Syringe
        c. Winged Infusion set (Butterfly)
    G. Failure to obtain blood
    H. Labeling
    I. Factors affecting test results

10/22/26

    J. Age-Specific Considerations

III. Capillary Collection Methods
    A. Finger sticks
    B. Heel sticks
    C. Video: Heelstick procedure

IV. Special Procedures
    A. Blood cultures

10/26/26

    B. Bleeding Time
    C. Glucose Tolerance Test
    D. Lactose Tolerance Test

10/28/26

    V. **FINAL EXAM**

Section 14

School of Medical Laboratory Science

HEMATOLOGY LECTURE OBJECTIVES

The student will, at the completion of the lectures, reading assignments, case studies and verbal instructions on Hematology by attaining a minimum of 70% on a written or oral exam:

I. INTRODUCTION AND ERYTHROPOIESIS

1. Recognize a normal peripheral blood smear and the following normal cells:
   - Neutrophils, segmented vs bands
   - Lymphocytes
   - Monocytes
   - Eosinophils
   - Basophils
   - Normal red blood cells
   - Platelets
2. Correlate all anticoagulants with the proper hematology tests.
3. Interpret a graph representing the location of erythropoiesis in the fetus and after birth.
4. Describe and identify chronologically the cells found in the RBC maturation series.
5. Illustrate and describe the steps in the synthesis of heme, globin, and hemoglobin.
6. Describe diseases or toxic states that cause a break in the synthesis of #4, such as lead poisoning and correlate with the blood picture.
7. List the normal globin chains of all the normal hemoglobins found in the fetus and in adults as well as other abnormal hemoglobins discussed in class.
8. Analyze the hemoglobin-oxygen dissociation curves and explain the causes that make the curve shift to the right and to the left. Analyze what happens to the affinity of hemoglobin for oxygen when the curve moves.
9. Explain the release of erythropoietin with regard to origin, function, and stimulus for its release.
10. Define cytokines and clinically correlate when they should be used to treat a patient.
11. Explain RBC senescence to include the organ system involved, the breakdown of hemoglobin and both extravascular and intravascular hemolysis.

II. ERYTHROCYTES

12. Identify normal morphology of human red blood cells on a blood smear.
13. Define the terms anisocytosis and poikilocytosis. Utilize these terms in describing a blood smear.
14. Identify the causes for abnormal RBC shapes and sizes.
15. Correlate abnormal RBC morphology with diseases and suggest future testing which may be helpful in establishing a diagnosis.
16. Interpret pictures, slides and blood smears of acanthocytes and correlate clinically to the disease.
17. Identify all the red blood cell inclusions discussed in class.
18. Describe the composition of each of the RBC inclusions. Clinically correlate the RBC inclusion with the appropriate disease.
19. Identify ringed sideroblasts and explain how and why they are formed.
20. Solve case studies given in class containing abnormalities on the blood smear to include rouleaux, RBC agglutination, polychromasia, macrocytosis, microcytosis, abnormal RBC inclusions, and any other RBC cell abnormality discussed in class.
21. Solve case studies illustrating diseases that demonstrate abnormal RBC morphology on the peripheral smear such as Thalassemia, iron deficiency anemia and Pernicious anemia.

III. LEUKOCYTES

22. Arrange and name the cells chronologically in the WBC maturation series.
23. Recognize a normal peripheral blood smear stained with Wright's stain.
24. Diagram the lymphocyte maturation series and name the cell at each stage.
25. Explain the characteristics of T, B, and null lymph cells with regard to laboratory identification. Describe the function of each immunologically and correlate with the CD classification.
26. Identify and name the stages in the maturation of the monocyte.
27. Identify the macrophage and explain the origin of these cells.
28. Explain the function of the macrophage.
29. Explain the causes for physiologic leukocytosis.
30. Identify inclusions inside WBCs such as Dohle bodies and toxic granulation. Correlate clinically these WBC inclusions to the appropriate disease or condition.
31. Calculate the absolute value for lymphocytes, neutrophils, eosinophils, segs or monocytes from the total white count and percent obtained on a differential.
32. Differentiate causes for pathological leukocytosis and correlate with the correct disease.
33. Identify eosinophils and basophils on a blood smear and clinically correlate increases to the correct condition or disease.
34. Analyze the function of all cells discussed in unit topic III.

IV. PLATELETS

35. Summarize (identify and name) chronologically the cells in the maturation series of the platelet.
36. Name the largest cell normally seen in a bone marrow smear.
37. Explain the function of the platelet
38. Estimate the platelet count by examining the platelets on a peripheral smear.
39. Clinically correlate normal and abnormal platelets on a blood smear.
40. Identify platelet satellitism on a peripheral blood smear stained with Wright's stain. Explain the cause of platelet satellitism and demonstrate how to correct for it.
41. Describe pathological platelet disorders and assess the need for laboratory testing in these conditions. Recommend tests that may be useful in making a differential diagnosis.

V. ERYTHROCYTE METHODS- RBC COUNTS

42. Perform the enumerative procedures for RBCs to include manual and automated counts.
43. Explain pre-analytical, analytical, and post-analytical components of RBC manual and automated cell counts.
44.. Calculate the correct number of cells counted when using the hemocytometer with different dilutions and volumes.
45. Perform testing on various types of hematology instruments such as Sysmex or Coulter. Trouble shoot each type of instrument and recognize when a discrepancy occurs. Devise a workable plan to correct the problem to the satisfaction of the instructor.
46. Recognize quality control discrepancies that may occur during the testing for RBC counts. Devise a plan to correct these discrepancies. (This objective may not be completely realized until the student has rotated through the hematology department.)
47. Clinically correlate abnormal RBC counts with pathological conditions.
48. Perform, solve quality control problems for, and clinically correlate results with the correct disease for hemoglobin and hematocrit testing
49. Perform and calculate retic counts. Calculate retic production index. Apply clinically the results obtained on a retic count.
50. Calculate the RBC indices to include MCV, MCH, MCHC and clinically correlate results with disease states.
51. Support the terms macrocytic, microcytic and normocytic, hypochromic, normochromic and hyperchromic with the correct RBC indices and anemia.

VI. ERYTHROCYTE METHODS- OTHER TESTING

52. Perform, solve quality control problems for, and clinically correlate results with the correct disease for the following RBC tests:

Sickle Cell (slide and tube test)
Erythrocyte Sedimentation Rate (ESR)
Osmotic fragility
Hemoglobin Electrophoresis
Ham's Test
Schilling test

53. Predict what additional testing would be helpful in establishing a diagnosis for diseases associated with the testing in #52.
54. Perform, solve QC problems for and resolve any issues that may occur while utilizing the following stains:
    Wright's Stain
    Prussian Blue
    Supravital Stains
55. Clinically correlate results for #54 with the correct disease.
56. Assess RBC enzyme testing that leads to the diagnosis of G-6-PD Deficiency. Justify how hemolytic episodes result from drug use when there is a G-6-PD deficiency.
57. Recognize blood smear abnormalities resulting from RBC enzyme deficiencies.
58. Resolve the likely disease when interpreting tests such as the Schillings Test.

VII. ERYTHROCYTE DISEASE

59. Define anemia.
60. Assign the various anemias into categories using the following descriptive words:
    - Macrocytic
    - Normocytic
    - Microcytic
    - Hemolytic anemia
    - Hyperchromic
    - Hypochromic
    - Normochromic

    Describe the clinical picture associated with each of the different types of anemia to include iron deficiency, acute blood loss, chronic blood loss, anemia of chronic disease, folate deficiency, Pernicious anemia, and various hemolytic anemias.
    Solve case studies related to the various anemias
61. Identify, interpret, and clinically correlate blood smears seen in an anemia and place in one of the categories listed in objective #60 with the use of RBC indices and/or other laboratory results
62. Describe pancytopenia and explain pathological conditions found in this type of hematology disease. List the causes of pancytopenia and the clinical prognosis. other laboratory test results.
63. Describe the general characteristics to include the following for the group of diseases discussed in class grouped together and called hemoglobinopathies:

- Blood smear morphology
- Supportive laboratory test results
- Patient symptoms
- Genetics
- Treatment
- Cause of the disease

64. Explain the genetics associated with hemoglobin S disease and trait and all the other hemoglobinopathies.
65. Draw genetic charts showing the inheritance patterns from different parents with the following diseases:
    - Hemoglobin S disease and trait
    - Hemoglobin C disease and trait
    - Hemoglobin D disease and trait
    - Hemoglobin E
    - Thalassemia major and minor
    - Sickle Cell-Hemoglobin C
    - Sickle Cell-Beta thalassemia
    - Alpha thalassemia
66. Appraise peripheral blood smears for hemoglobinopathies and clinically correlate the findings to the correct disease.
67. Select the appropriate reagents utilized in the testing for hemoglobinopathies.
68. Analyze case studies of hemoglobinopathies. Suggest testing which may be helpful and make a correct diagnosis.
69. Describe polycythemia and clinically correlate testing results with this disease.

VIII. LEUKOCYTE METHODS

70. Perform leukocyte enumerative procedures in both manual and automated methods.
71. Clinically correlate results of WBC counts to the appropriate clinical disease or as normal.
72. Make judgments concerning WBC counts for the following:
    - Need for additional testing
    - Validating methodology
73. Perform manual WBC differentials (100 cells). Recognize and correctly identify both normal and abnormal WBCs
74. Correct the calculation for the WBC count when NRBC are present on the peripheral blood smear.
75. Perform eosinophil counts and clinically correlate the results with disease or health.

76. Describe lupus erythematosis to include the following:
    - Patient characteristics

- ANA Test results
- Fluorescent patterns seen in ANA and antigen indicated
- Prognosis
- Treatment
- Other useful and supportive lab tests
- Etiology

77. Identify an LE cell and explain how it is created in the laboratory.
78. Identify a Tart cell and explain how it is created.
79. Perform and clinically correlate results with the disease for the following stains:
    - Peroxidase
    - Periodic-Acid –Schiff
    - Sudan Black
    - Leukocyte Alkaline Phosphatase
    - TdT
    - Cytochemical esterases
    - Tartrate Resistant Acid Phosphatase
80. Correlate the leukemia with the appropriate stain that is positive.
81. Apply the use of stains to conditions other than leukemia such as leukemoid reactions.
82. Calculate a LAP score and correlate the score with health or disease.

IX. LEUKOCYTE ANOMALIES

83. Explain the formation of the Philadelphia chromosome and correlate its presence to the appropriate leukemia. Relate which two chromosomes are affected and how they are affected.
84. Identify the peripheral blood smears seen in the various WBC anomalies and diseases listed below. Explain the etiology of each:
    - Pelger Huet
    - May-Hegglin
    - Chediak-Higashi
    - Alder-Reilly
    - Hunter's
    - Hurlers.
    - Sezary syndrome
    - Chronic granulomatous disease
    - Infectious mononucleosis
85. Clinically correlate the peripheral blood smear of the anomalies with the disease.
86. Assess the test results on a patient with elevated band neutrophils, and correlate this result with the possibility that this may be a patient with a Pelger Huet anomaly. Recognize "pince nez" and correlate it to Pelger Huet anomaly.
87. Solve case studies of theWBC anomalies and diseases discussed in class.
88. Discuss Sezary Syndrome to include etiology, blood picture, and test results. Solve

case study results on patients with Sezary Syndrome.

89. Identify auer rods and correlate to the appropriate leukemia. Describe the composition of auer rods.
90. Explain cluster of differentiation (CD) and correlate to specific diseases.
91. Relate the severity of neutrophilic leukocytosis to the five factors given in class.
92. Clinically correlate toxic granulation and Dohle bodies to a severe infection. Identify both of these on a peripheral blood smear.
93. Assess factors associated with infectious mononucleosis to include etiology, blood picture, serology test results, physical characteristics, and transfer of the disease.
94. Solve case studies given in class on patients with infectious mononucleosis.
95. Describe parasitic infections caused by *Plasmodium vivax, Plasmodium malariae, Plasmodium falciparum* and *Plasmodium ovale*. Identify the presence of the parasites on a peripheral blood smear. Solve case studies in class on patients with malaria.
96. List inherited disorders of lipid metabolism and identify the characteristic cell found in Gaucher's disease and Neimann-Pick disease.
97. Analyze the characteristics of leukemoid states and leukemia with the goal of differentiating the two. Relate LAP scores to each.
98. Describe the classification given to the respective leukemias with regard to acute vs. chronic and the predominate cell type found in each.
99. Determine the most likely leukemia from case studies given in class by assessing the hematology lab test results, age of patient, the cytochemistry (stains), peripheral and bone marrow smears, and physical characteristics of the patient.
100. Analyze these cases to identify if one or more of the characteristics do not seem to correlate. Devise a plan to determine the cause of this discrepancy.
101. Describe the FAB classification with regard to morphology and cytochemical evaluation of leukemic cells. List the words that are described by FAB.
102. List the characteristics of chronic leukemia and related lymphoproliferative disorders.
103. Recognize the clinical blood picture and correlate lab tests with the diagnosis of all the leukemias.
104. List and interpret the lab findings for chronic myeloproliferative disorders. Clinically correlate blood smears of these disorders to the disease. Suggest further testing that may aid in the diagnosis.
105. Evaluate characteristics that are found in myelodysplastic syndromes to include patient clinical symptoms, blood smears and lab tests. Recognize the need for further testing and list helpful tests that can distinguish the various clinical diagnoses for myelodysplastic syndromes.
106. Describe the etiology, physical characteristics of the patient, peripheral and bone marrow pictures, laboratory test results for the following:
    - Hodgkins disease
    - lymphomas
    - multiple myeloma
    - Waldenstrom macroglobulinemia

- Lupus erythematosus

Assess case studies for all the diseases listed above and correlate laboratory results to the correct disease. Evaluate if a discrepancy exists in the case study, or if one of the results does not correlate with the rest of the characteristics, and devise a plan to determine the cause of the discrepancy.

X. PLATELETS

107. Perform platelet counts and clinically correlate results with disease or health to include counts done either manually or by instrument.
108. Perform, describe, interpret results and clinically correlate test results for the following platelet/coagulation/hematology tests:
    - Platelet aggregation studies (include change in %T and all aggregating agents listed in your text)
    - Closure Time—PFA-100 (Siemens)
    - PT
    - PTT
    - Ivy Bleeding Time
109. Explain pre-analytic, analytical, and post-analytical components of the platelet tests listed in #108.
110. Analyze quality control discrepancies and devise a plan to correct the discrepancies for all platelet tests.
111. Identify platelets, both normal and abnormal, on a peripheral smear, colored picture, photomicrograph, or Power-Point slide.
112. Define thromobocytopenia, thrombasthenia and thrombocythemia.
113. Describe the test results and clinical symptoms found in ITP and TTP.
114. Describe the etiology, test correlation to disease, and differentiating tests useful in the following disease/condition/situation:
    - Glanzmann's thrombasthenia
    - Von Willebrand'd disease
    - Bernard Soulier syndrome
    - Platelet storage pool defects
    - ITP
    - TTP
    - Wiskott-Aldrich syndrome
    - Alport's syndrome
    - Hermansky-Pudlak syndrome
    - TAR syndrome
    - Aspirin ingestion
    - Cardiopulmonary bypass in surgery
115. Perform an estimated platelet count on a peripheral blood smear. Calculate the estimate on blood smears stained by automated stainer and by manual staining.

116. Apply knowledge to make decisions about the need for future testing when examining abnormal platelet counts.

XI BONE MARROW IN PATHOLOGICAL STATES

117. Interpret normal and abnormal bone marrow slides and correlate to the correct disease.
118. Identify a normal and abnormal M:E ratio and correlate to the correct disease.
119. Describe possible causes for an abnormal M:E ratio.
120. Perform a bone marrow differential blood count.
121. Identify normal and abnormal blood cells on a stained bone marrow smear.
122. Describe the possible sites for a bone marrow aspiration.
123. Describe the steps utilized in a bone marrow aspiration and obtaining the sample for analysis.
124. Interpret bone marrow differentials for correlation of results with the patient's diagnosis. Recognize when results do not correlate with the patient's symptoms and peripheral blood findings. Investigate why this has occurred and resolve the discrepancy.

XII. HEMATLOGY INSTRUMENTATION

125. Perform testing and describe the methodology on the following instruments/instrumentation used in the hematology department to include solving quality control discrepancies:
    - Coulter Counter—Coulter Model A—include VCS Technology
    - Beckman Coulter LH
    - Flow Cytometry
    - Coulter STKS
    - Platelet Aggregometer
    - Aerospray Slide Stainer
    - Stago STA Compact Coagulation Instrument
    - Platelet Function Analyzer 100 (PFA 100)
    - Sysmex XN3000
    - HemataStat II
    - Hema-Tek 2000
    - ESR Auto Plus
126. Trouble shoot and identify discrepancies when an instrument malfunctions or an instrument reports test results incorrectly. Device a plan to correct this problem.
127. Interpret hematology instrument histograms and correlate the results to the appropriate disease or health. Correlate histogram shifts to left and right with condition.

128. Describe tests which are calculated by the various instruments. Assess disorders from instrumentation test results to include the following:

- Red cell parameters such as RBC count, Hgb, Hct, MCV, MCH, MCHC, along with RBC histograms
- RDW
- Platelet counts, MPV, PDW
- Leukocyte differential analysis
- PT
- PTT
- Other histograms and scatter plots

129. Identify hematology instrument testing results that occur as the result of cold agglutinins in the patient's sample. Correct this problem when operating the hematology instrument. Correlate peripheral blood smear with cold agglutination.
130. Research various hematology instruments and methods and identify which instrument and/or method best meets your laboratory's needs.
131. Evaluate the workflow in the RMH Hematology Department, and make suggestions for improvement. Create a flow diagram of the workflow in hematology, and give suggestions that will shorten the turn-around-time for testing.
132. Design a hematology department for a 400 bed hospital including reagents, instruments, staffing, space and quality control methods. Present the design in class.

CASE STUDIES IN HEMATOLOGY

133. Analyze test results to identify the disease being presented by the case study.
134. Identify the need to do additional testing when making a diagnosis.
135. Identify test results that do not correlate.
136. Describe the over-all disease process in the patient for all case studies.
137. Develop a positive attitude so that their knowledge in hematology has progressed to the point that functioning in a hematology department as a clinical laboratory scientist is eminent.
138. Demonstrate a professional image when discussing hematologic diseases.

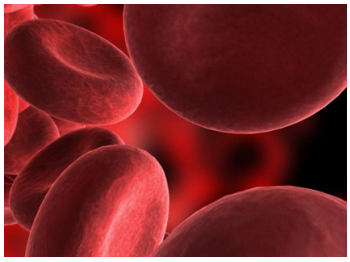
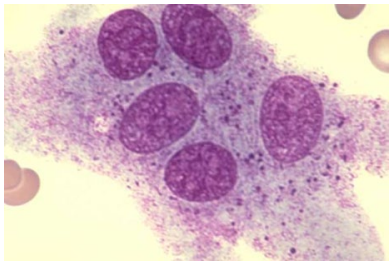
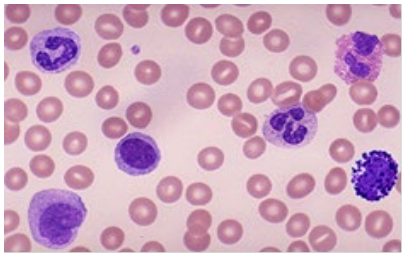
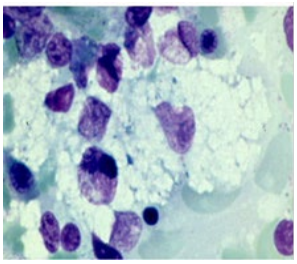
STUDENT PRESENTATION OF TWO HEMATOLOGY DISEASES

139. Feel comfortable when discussing hematology diseases.
140. Develop a deeper understanding of the two diseases presented by the student.
141. Answer questions concerning their topic
142. Utilize the information presented by the other students as a general review for the course.
143. Feel at ease when making an oral presentation.

XIII. MOLECULAR DIAGNOSTIC TECHNIQUES IN HEMATOPATHOLOGY

144. Explain and identify the fundamental structure of DNA.
145. Define and explain nucleic acid probe.
146. List the purpose of the most commonly used molecular diagnostic assays.
147. Describe the procedure and clinically correlate the results for the following tests: Southern blot, PCR, Reverse transcriptase PCR, and in Situ hybridization.
148. Identify a potential clinical application for each molecular diagnostic test. Describe the procedure for obtaining the sample.
149. List the steps in the PCR procedure describing each in detail.
150. Perform PCR testing while running the correct controls.
151. Solve complex problems in the hematology department involving QC results, testing discrepancies, instrument malfunction, sample inconsistencies and reagents; and devise a plan to correct these problems to the satisfaction of the instructor.

MT 400 Clinical Hematology

Instructor: Abigail Blosser, B.S., MLS (ASCP)^{CM}

Method of Instruction: Lecture, discussion, question and answer

Course Goal: To educate the student in Hematology, Coagulation, and Genetics so they may function as a beginning level technologist/scientist in the clinical hematology laboratory.

Textbooks:

McPherson and Pincus, *Henry's Clinical Diagnosis and Management by Laboratory Methods*, 23rd edition, 2017

Harmening, Denise M. Clinical Hematology and Fundamentals of Hemostasis. Philadelphia, PA: F.A. Davis Company, 2024, Sixth Edition, ISBN # 978-0803694439.

Bell and Sallah, *The Morphology of Human Blood Cells*, Abbott, Seventh Edition, 2005

Pre-requisite Courses: 3 years of college with required science courses plus guarantee of BS degree upon completion of clinical year

Instructions: Bring texts to class every day.

CLINICAL HEMATOLOGY LECTURE SCHEDULE

DATE:		TOPIC:	READING ASSIGNMENT:
6/17/26	I.	Introduction to Hematology a. Blood b. Hematopoiesis c. Erythropoiesis i. RBC maturation series ii. RBC membrane d. Hemoglobin i. Structure and function ii. Heme synthesis iii. Globin synthesis iv. Normal v. Abnormal vi. Function e. RBC metabolism f. RBC senescence	Chapter 1
6/19/26 6/22/26	II.	Erythrocytes a. Normal morphology b. Abnormal morphology i. Anisocytosis ii. Poikilocytosis iii. RBC inclusions	Chapters 3-5
6/24/26		**Exam 1**	
6/25/26	III.	Leukocytes a. Myelopoiesis b. Granulocytes c. Lymphopoiesis d. Lymphocytes i. T-cells ii. B-cells iii. Null-cells e. Monocytes f. WBC count i. Physiological leukocytosis ii. WBC differential iii. Absolute counts	Chapter 1, 4 & 16
6/29/26	IV.	Platelets a. Function b. Morphology c. Production d. Structure e. Platelet count	Chapters 1, 4, & 25

CLINICAL HEMATOLOGY LECTURE SCHEDULE

DATE:		TOPIC:	READING ASSIGNMENT:
7/1/26	V.	Erythrocyte Methods a. Enumerative procedures i. Automated count ii. Manual count iii. Retic count b. Hemoglobin and hematocrit c. RBC indices	Chapter 31
7/6/26		**Exam 2**	
7/13/26	VI.	Erythrocytes a. Basic tests i. Hemoglobin S ii. ESR (Erythrocyte Sedimentation Rate) iii. Osmotic fragility iv. Hemoglobin electrophoresis v. Sugar water test vi. Ham's test vii. Schilling test b. Cytochemistry i. Wright's stain and variations (Romanowsky stain) ii. Prussian blue (Iron stain)	Chapter 31
7/15/26 7/17/26 7/20/26 7/22/26	VII.	Erythrocyte Diseases a. Anemias i. Normocytic 1. Acute blood loss 2. Hemolytic 3. Aplastic 4. Myelophtisic 5. Hypo-proliferative ii. Macrocytic 1. Megaloblastic 2. Other iii. Microcytic 1. Iron deficiency 2. Sideroblastic 3. Hereditary hemochromatosis iv. Hemoglobinopathies and Thalassemia's b. Polycythemia	Chapters 4, and 6-15

CLINICAL HEMATOLOGY LECTURE SCHEDULE DATE: TOPIC: READING ASSIGNMENT:

7/24/26 & 7/27/26 REVIEW I & II

7/30/26 **Exam 3**

7/31/26 VIII. Leukocyte Methods Chapters 16, 17 & 36
8/3/26

a. Enumerative procedures
    i. Manual
    ii. Automated
    iii. Differential
    iv. WBC estimate
    v. Correction for nRBCs
    vi. Eosinophil count
b. Basic tests
    i. LE (Lupus Erythematosus)
c. Cytochemistry
    i. Peroxidase
    ii. Periodic-Acid-Shiff
    iii. Sudan black
    iv. Leukocyte Alkaline Phosphatase
    v. TdT
    vi. Cytochemical esterase's
    vii. Tartrate Resistant Acid Phosphatase (TRAP)

8/5/26 REVIEW

8/7/26 **Exam 4**

8/11/26 IX. Leukocyte Anomolies Chapters 17 – 24
8/12/26
8/14/26
8/17/26

a. Neutrophil disorders
b. Reactive lymphocytes
c. Leukemia
    i. Acute lymphoblastic
    ii. Acute myeloid
        1. M0
        2. M1
        3. M2
        4. M3
        5. M4
        6. M5
        7. M6
        8. M7
    iii. Chronic lymphocytic
        1. Hairy cell

CLINICAL HEMATOLOGY LECTURE SCHEDULE

DATE:		TOPIC:	READING ASSIGNMENT:

2. Sezary
3. Lymphomas
4. Multiple myeloma
5. Waldenstrom's macroglobulinemia

iv. Chronic myeloproliferative disorders
1. CML
a. Philadelphia chromosome
b. Chronic neutrophilic leukemia
c. Chronic eosinophilic leukemia
2. Polycythemia Vera
3. Essential thrombocythemia
4. Idiopathic myelofibrosis

v. Myelodysplasias
1. RA – refractory anemia
2. RARS
3. RAEB
4. RAEB-t
5. CMML

vi. Lipid storage diseases
1. Gaucher's
2. Niemann-Pick
3. Tay-Sachs

8/19/26 Hematology Case Studies and REVIEW

8/21/26 **Exam 5**

8/24/26 & 8/26/26 X. Platelets — Chapters 25 - 29

a. Structure and function
b. Test methods
i. Specimen
ii. Manual count
iii. Smear estimate
iv. Automated count
v. Bleeding time
vi. Aggregation studies
vii. PFA-100
c. Disorders
i. Thrombocytopenia
ii. Thombasthenia
iii. Thrombocytosis

CLINICAL HEMATOLOGY LECTURE SCHEDULE

DATE:		TOPIC:	READING ASSIGNMENT:
8/28/26		Bone Marrow in Pathological States	Chapter 3
9/1/26	XI.	**Exam 6**	
9/3/26	XII.	Hematology Instrumentation	Chapters 5, 32, & 34
9/4/26	XII.	Molecular Diagnostic Techniques in Hematopathology a. Applications of DNA technology to diagnostic medicine b. Structure of DNA c. Sample sources for molecular procedures d. Sequence-specific fragmentation of DNA by restriction endonucleases e. Nucleic acid extraction f. Diagnostic procedures for analyzing DNA i. Southern blot analysis, PCR, reverse transcriptase PCR, in situ hybridization	Chapter 35
9/9/26	REVIEW &	Student Presentations on Assigned Disease **(Submit ONLINE)**	
9/11/26	REVIEW		
9/14/26	**Final Exam**		

Section 15

School of Medical Laboratory Science
Clinical Chemistry Lecture Objectives

The student will at the completion of the chemistry lectures, reading assignments and chemistry rotation by obtaining a minimum of 70% on a written exam, practical exam or rotation evaluation unless otherwise stated:

Topic: **Chemistry Lab Principles**
Pipets, **Safety, Instrumentation**, **Quality Control/Statistics**, **Beer's Law, Instrumentation**

1. Correctly pipet with volumetric, serological, micro, TC, TD, and frosted ring pipets.

2. Make conversions in the Metric System. Explain OSHA and CDC mandated safety plans for the laboratory (MSDS sheets, chemical hygiene plan, exposure control plan.)

3. Perform calculations using Beer's Law. Make judgments concerning the use of standards to either draw a curve or calculate an unknown from a standard. Apply Beer's Law with regard to graphs on linear versus log graph paper and plots for concentration as compared to absorbance or %T.

4. For the following instruments, the student will:

a. operate according to the procedure manual to satisfaction of instructor
b. correct problems when instruments malfunction
c. determine when it is appropriate to call the instrument company for help in trouble shooting problems
d. explain the principle of the methodology utilized on each instrument
e. clinically correlate test results on the instruments with disease or health
f. calculate results appropriate for different instruments, for example, calculation of the Rf value for chromatography

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Fluorometer
Atomic absorption
Nephelometer
Electrophoresis

Osmometer
Chromatograph
Abbott Axsym
Ion specific electrode
pH Meter
Centrifuges
Cliniteck Atlas
Vitros 950 and ECI
Fiske 2400 Osmometer
Criterion II Chemstrip
BD Probetec ET
Siemens Vistas
Abbott AXSYM
Vitros ECI
Spectrophotometer
Flow Cytometry
Luminescence
Chemiluminescence
Fusion 5.1
Variant II
Urisys 2400 and UF-100
Biosite Triage Test Meter: BNPep and Tox Drug Screen

5. Explain the principles of the following methods:
- Turbidimetry and Nephelometry
- Electrochemistry, Potentiometry, Coulometry, Biosensors
- Electrophoresis, Immunoelectrophoresis, and Immunofixation electrophoresis
- Immunochemical techniques, ELISA
- Fluorescence polarization immunoassay and Automation—Robot Arms

6. Select the best instrument for clinical chemistry testing according to the following:
- Data on the variety and number of tests done in the department
- Cost of each test
- Cost of reagents
- Availability of instrument
- Cost of technologist time

7. Select the best method for use in the laboratory by examining the standard deviation, mean, and calculating the CV.

8. Define the following to include formula if applicable:
- Buffer
- ASCP
- Analytical sensitivity
- Youden Plot
- JCAHO

- CLSI
- Normal Values

9. Calculate the acceptable range for a control in the laboratory when the mean and standard deviation are given.

10. Analyze Levey-Jennings quality control charts by doing the following:
- Identify an upward and downward shift and trend
- Apply quality control rules to determine the possible cause of an error
- Correct an error

11. Define accuracy, precision, and variance.

12. Calculate the value of the unknown when the method is linear from the O.D. of the unknown, the O.D. of the standard, and the concentration of the standard.

13. Interpret values for the standard deviation and coefficient of variation.

14. Draw a normal Gaussian Curve and give the % of values included under + and - 1 SD, + and - 2SD and + and - 3SD.

15. Calculate the mean, median, mode and standard deviation.

16. Assess the similarity between the use of reference and measuring light beams in double-beam atomic absorption spectrophotometry for use as the internal standard in flame emission photometry.

Topic: **Proteins & Amino Acids**

17. Analyze and perform serum, plasma, and CSF protein electrophoresis scans by doing the following:
- Clinically correlate scans with the appropriate disease
- Identify the scan as being from either serum, plasma, or CSF
- Perform the scan according to the procedure manual to the satisfaction of the instructor

18. Clinically correlate test results from patients with multiple sclerosis.

19. Correlate clinically test results for total protein, protein electrophoresis, albumin and globulin to the correct disease.

20. Draw protein electrophoresis scans and label the negatively charged electrode, positively charged electrode, anode, cathode, direction of migration, and order of migration of the various proteins.

21. Assess protein electrophoresis scans to determine if trailing or other distortion has occurred during the electrophoresis. Correct these occurrences by altering the voltage etc.

22. Describe the metabolism, function, synthesis and catabolism for all the proteins discussed in class.

23. Write the principle of all the protein methods discussed in class and include causes for false positives and negatives.

24. Analyze protein lab results and determine if future testing might be beneficial in making the patient diagnosis. Recommend which tests might be the most helpful.

25. Describe the proteins in other body fluids, their methods for measurement, and clinically correlate the test results to health or disease.

26. Determine the validity of all protein testing.

27. Analyze quality control results and identify any discrepancies that may occur. Devise and implement a plan to correct these discrepancies.

28. Evaluate laboratory data to establish reference range criteria, and to determine alternate test methods.

29. Evaluate laboratory data to resolve possible inconsistent results/sources of error.

Topics: **Enzymes**, **Carbohydrates and Lipids**.

30. Interpret lipid profile results and correlate results with disease or health. Explain the metabolism of the various lipids discussed in class. Correlate serum/plasma specimen appearance with elevated and normal lipid test results.

31. Calculate the LDL value from the triglyceride, total cholesterol and HDL cholesterol. Determine when this formula may not be used to calculate the LDL cholesterol.

32. Analyze patient results (cholesterol, triglyceride, HDL and LDL cholesterol, apoproteins, CRP--high sensitivity, homocyststeine) to determine which patient has an increased or decreased risk for coronary artery disease.

33. Describe an L/S Ratio and clinically correlate the result to a mature fetus or immature fetus.

34. Explain the principles of all lipid methods, to include false positives and negatives, specimen requirements and plasma/serum appearance (normal and elevated).

35. Explain and clinically correlate the following with regard to carbohydrates:
- Metabolism “at rest” and following exercise
- Glucose tolerance test and correlate results to disease
- The Diabetic Association recommendations for making a diagnosis of diabetes mellitus
- Glycohemoglobin and its usefulness for diabetic patients

- Glycogen storage disease
- Metabolism of lactate and pyruvate

36. Classify lipids using the two methods of electrophoresis and ultracentrifugation. Draw lipoprotein electrophoresis showing order of migration and sequence of fractions.

37. Interpret quality control measurements utilized in lipid, glucose and enzyme testing to determine if the method has accuracy and precision.

38. Correlate clinically the "good" and "bad" cholesterol. Write the normal values for all the lipid parameters.

39. Explain methodology & clinical correlate results for all methods to measure glucose. Write the formula for glucose oxidase to measure glucose.

40. Explain methodology & clinically correlate results for all lipids.

41. Describe enzyme nomenclature. Calculate enzyme values when sample dilutions are made.

42. Draw and explain the Michaelis-Menten curve labeling the parts and identifying first and zero order kinetics. Interpret the Lineweaver-Burk Plot.

43. Explain the various factors that affect enzyme reactions to include the following: substrate concentration, pH, temperature, activators, inhibitors, cofactors, enzyme concentration and coenzymes.

44. Explain the following for the list of enzymes:
- Basic reactions that they catalyze
- Diseases where they show an elevation and recommend useful additional testing
- Variation in control results while performing the testing
- Plan of action if test results do not meet established QC rules

AST
ALT
Creatine Kinase CK
Lactate Dehydrogenase LD
Alkaline and Acid Phosphatase
Gamma Glutamy Transferase
Alpha Amylase and Lipase
Cholinesterases
Aldolase
LD Isoenzymes
CK Isoenzymes
PSA (Prostate Specific Antigen)
Angiotensin-Converting Enzyme (ACE)
Chymotrypsin
Trypsin

5'Nucleotidase
Glutamate Dehydrogenase
Isocitrate Dehydrogenase
BNP (a cardiac hormone)

45. Describe the origin and function of each enzyme listed in number 44. Draw CK and LD electrophoresis showing order of migration from fastest to slowest fractions.

46. Discuss isoenzyme separation techniques for alkaline phosphatase to include heat and electrophoresis. List what isoenzyme disappears 1st, 2nd and 3rd with heating at 56 °C.

47. Describe test results which go up following a myocardial infarct to include CK and CKMB, LD, myoglobin, AST, troponin I and T, BNP to include the time that the elevation occurs following an MI, and how long the elevation lasts. Relate which test goes up first, second etc. and which comes down first, second etc. Explain which test or tests is/are more specific in determining a MI (myocardial infarction). Describe which tests are currently being used to evaluate patients with a possible myocardial infarct. Explain the use of homocysteine in evaluating patients with a MI.

48. Describe where on the Michaelis-Menten Curve that testing for enzymes should occur and why.

49. Calculate enzyme activity rate.

50. Assess the overall status and the fetal lung maturity for a fetus when the weeks of gestation, lecithin, sphingomyelin, bilirubin scan on amniotic fluid, and delta absorbance at 450 nm are given.

51. Determine the best course of action to follow when you are asked to perform a specialized chemistry test that you are familiar with but not exactly certain of the steps required in the test.

52. Analyze instrument results such as seen on an ion selective electrode and determine the course of action if a problem is discovered such as a message saying "repeated drift."

Topics: Vitamins and Trace Elements

53. List the fat and water soluble vitamins and the foods that contain these vitamins.

54. Explain the principles for methods used to measure these vitamins.

55. Clinically correlate vitamin deficiency and excess with disease or health.

56. Describe the need for trace elements such as magnesium, iron, zinc, copper etc. Explain the etiology of Wilson's disease and correlate lab results with the disease.

Topic: Endocrinology

57. Describe the action, biosynthesis, metabolism, control mechanisms, and site of production for the following: Analyze test results to determine the presence of pathology or health for the following: insulin, GH, Endorphins, LH, FSH, TSH, Steroid Hormones, Cortisol, aldosterone, Testosterone, Progesterone, Estrogens, Thyroid hormones, catecholamines, Serotonin, 5-HIAA, hCG, estriol, estradiol and all other hormones given in class. Solve case studies involving these hormones.

58. Explain the principles of the methods used to measure all the hormones in #1. Explain the ***anatomy & physiology*** of the following glands: adrenals, pituitary, hypothalamus, pineal, ovary, testis, placenta, and pancreas. Describe the Porter Silber Method and the Zimmerman reaction. Explain why sodium bismuthate is used prior to the Zimmerman reaction. Relate increases and decreases of the 17-ketosteroids to diseases/conditions. Explain what substances can cause interferences in the Porter-Silber reaction.

59. Analzye quality control data to determine if the control values for hormone tests meet the applied quality control rules. Formulate a course of action to identify and correct the error.

60. Research methodology for hormone testing, interpret data and select the best method.

61. Describe the function, metabolism, and site of production of catecholamine and serotonin. Explain pheochromocytomas or neuroblastomas and what laboratory tests are used to evaluate these conditions. Clinically correlate testing for serotonin and 5-HIAA with disease or health.

62. Clinically correlate test results to Addison's Disease and Cushing Syndrome.

63. Draw the cyclopentanoperhydrophenanthrene ring and list all the substances that contain this ring system.

Topic: Electrolytes, Blood Gases, and pH

64. Calculate the anion gap and interpret the results. Assess if electrolytes are in balance. Analyze patient case studies and compare the calculated osmolality with the measured osmolality. Correlate these results with health or disease.

65. Describe and correlate clinically the intracellular and extracellular anions and cations. Describe the functions and all regulatory mechanisms for all the electrolytes. Define anion and cation and place each electrolyte in one of the two categories.

66. Explain the principles of methods for measuring the electrolytes. Discuss the ***anatomy & physiology*** of the lungs.

67. Assess quality control results to determine the validity of electrolyte test results.

68. Describe causes for increases and decreases in electrolyte values and correlate to the appropriate disease. Explain the effect on the body when electrolytes are outside the normal range.

69. Describe the four body buffer systems and identify the most important system. Discuss the bicarbonate to carbonic acid normal ratio and describe what affects this ratio. Define the term, "buffer."

70. Calculate values using the Henderson-Hasslebach equation.

71. Describe the chloride shift and list electrolytes that participate in the shift. Describe what goes into the cell and what comes out.

72. Describe and interpret the hemoglobin-oxygen dissociation curve. Identify the effects of pH, temperature, pCO2, PRG/Hb ratio and O2 on the curve. Assess conditions which cause the curve to shift to the right or to the left.

73. Describe the principles of methods for measuring blood gases (to include PCO2 electrode, and PO2 Clark electrode), urine and serum osmolality, and pH (pH meter and calibration), and correlate these results clinically to pathology or health. Explain the measurement of P_{50} and clinically correlate it's test results to disease or health. Define tonometry.

74. Describe the proper blood collection for blood gases. Determine when blood gases have not been collected correctly when given a situation or patient case study.

75. Solve case studies when given blood gas results and correlate these results to metabolic acidosis or alkalosis and respiratory acidosis or alkalosis. Explain the normal response of the body to these conditions.

76. Make judgments when deciding what types of future tests need to be done on a patient to determine or confirm a diagnosis concerning acid/base balance.

77. Analyze quality control data to make decisions concerning release of test results and need for repeat testing.

78. Evaluate laboratory data to establish testing procedures for alternate methods, and to establish reference range criteria.

78a. Calculate the osmolality from the BUN, glucose, and sodium.

78b. Describe 'Point of Care' Testing and explain why this form of testing emerged in the present health care system.

Topic: Non-Protein Nitrogen Metabolites and Renal Function

79. Describe the origin and metabolism of the non-protein nitrogenous compounds to include urea, creatinine, creatine, uric acid, and ammonia. Discuss the principles of methods used to

measure these and clinically correlate test results to disease or health. Solve renal patient case studies given in class. Discuss the ***anatomy & physiology*** of the kidney.

80. Analyze nitrogen metabolites test results and determine the need for future testing to confirm or assess renal pathology. Distinguish between tubular and glomerular diseases by assessing test results.

81. Explain the special collection procedures necessary when collecting an ammonia sample.

Topic: Parathyroid Function

82. List the hormones associated with the parathyroid. Explain the principles for methods used to measure calcium, phosphorus, and magnesium. Describe the function and metabolism of calcium, phosphorus, and magnesium. Discuss the ***anatomy & physiology*** of the parathyroid gland.

83. Correlate clinically test results for serum calcium and phosphorus and urine calcium and phorphorus that are seen in hyperparathyroidism and hypoparathyroidism as well as other diseases.

84. Clinically correlate the test results for calcium, phorphorus, and magnesium to pathological conditions or health.

85. Describe the forms that calcium takes in the body.

86. Research methodology and determine the best method for measuring calcium, phosphate, and magnesium.

87. Analyze quality control data utilized in testing for calcium, phosphate, and magnesium and determine if there is a discrepancy in the data. Identify the cause of the discrepancy and devise a plan to correct the discrepancy.

Topic: Therapeutic Drug Monitoring and Toxicology

88. List drugs included in each of the following groups and explain the principles of methods used to measure these drugs. Discuss the therapeutic range for each of the drugs in these groups and explain how this range is reached. Discuss metabolites (and toxic effects) of these drugs that may accumulate in the patient and cause problems.

For Therapeutic Drugs:	***For Toxicology:***
Antiepileptic Drugs	Acetaminophen, salicylate, alcohols,
Cardioactive Drugs	barbiturates, carbon monoxide,
Bronchodilators	cyanide, amphetamine, cannabinoids,
Antibiotics	cocaine, opiates, PCP, aluminum,
Antipsychotic Drugs	arsenic, cadmium, chromium, cobalt,
Anti-Depressants	copper, iron, lead, magnesium,
Neuoleptic Drugs	mercury, nickel, platinum, selenium,

Antineoplastic Drugs Immunosuppressants	silicon, silver, and thallium

89. Assess test results for the drugs in the above groups and determine the validity.

90. Solve case studies given in class by correlating drug testing results with evidence of abuse, non-compliance with dosage, toxic levels of drug from exposure etc.

91. Perform research and interpret the data to determine the best and most cost effective methods for measuring therapeutic drugs and drugs of abuse.

92. Analyze data on area demographics and physician mix with the goal of setting up a therapeutic drug monitoring and toxicology laboratory.

93. Explain how many doses are usually necessary to reach a therapeutic range.

Topics: Hemoglobin, Myoglobin, Porphyrins, and Iron

94. Describe the metabolism and storage forms of iron. Describe transferrin and its function and principles of tests to measure it. Describe tests to measure iron and discuss the difference between iron methods and TIBC methods.

95. Interpret hemoglobin electrophoresis scans at an acid and alkaline pH. Correlate the appropriate disease state with the electrophoresis scan.

96. Correlate clinically Fe and TIBC test results for such diseases as Fe deficiency anemia, anemia of chronic disease, hemochromatosis, and all other diseases. List conditions that have an elevated serum iron and a decreased serum iron.

97. Describe the function and metabolism of hemoglobin and myoglobin.

98. Describe disorders that affect Fe metabolism.

99. Explain the principles of methods to measure hemoglobin, myoglobin, porphyrins, iron, and TIBC. Discuss the steps in the procedures. Assess test results to determine the validity of the test.

100. Interpret quality control data to identify occurrences where the quality control rules have not been met. Investigate to determine the cause of any discrepancies.

101. Describe the metabolism of porphyrins.

102. Describe the Watson-Schwartz test and correlate the results to health or disease.

103. Investigate new methodology for the testing of hemoglobin, myoglobin porphyrin, iron, and TIBC. Interpret research data and select the most accurate and precise method. Calculate and interpret the coefficient of variation when comparing methods.

Topics: Liver Function and Hepatitis

104. Explain the metabolism of bilirubin including all the steps presented in class. Identify characteristics of unconjugated and conjugated bilirubin. Describe why bilirubin is conjugated in the liver. Discuss the ***anatomy and physiology*** of the liver.

105. Correlate clinically test results with pre-hepatic, hepatic and post- hepatic jaundice as well as with other liver disorders.

106. Solve case studies from given patient results and correlate to the appropriate liver disease.

107. Describe principles of methods for bilirubin, urobilinogen, urobilin, liver enzyme tests, hepatitis and other liver function tests.

108. Make judgments concerning discrepancies in test results or when the Q.C. system does not meet the quality control rules. Devise a plan to determine the cause of discrepancy and correct it. For example, when the control for the method has been continuing to increase over a period of six days as seen on the Levy Jennings QC chart.

109. Recommend possible additional tests that may be helpful to confirm hepatic pathology or to monitor a known hepatic abnormality such hepatitis, obstructive jaundice or pre-hepatic jaundice. Discuss the clinical correlation of alpha fetoprotein with hepatoma and pheochromocytoma.

110. Explain the different types of hepatitis that can lead to liver cancer.

111. Clinically correlate elevated test results for all stages and types of hepatitis to include HAV, HBV, HCV, HDV, HEV, and HGV. Indicate chronologically when tests are elevated or normal.

112. Research methods to determine the most cost effective, most accurate and reproducible procedures for evaluating hepatic function.

Topic: Gastric, Pancreatic, and Intestinal Function

113. Describe the gastrointestinal and pancreatic hormones, their action, and the stimulus for their release and control mechanisms. Explain the ***anatomy & physiology*** of the stomach, pancreas & intestine.

114. Explain the principles of the gastric and pancreatic function tests. Clinically correlate these test results to disease or health.

115. Describe the principle of the Sweat Test, clinically correlate the results to health or disease. Determine when there is a need to do additional testing to confirm a diagnosis of Cystic Fibrosis.

116. Explain the two pathological conditions called peptic ulcer and Zollinger-Ellison Syndrome. Describe the etiology.

117. Determine the validity of testing results and interpret quality control data with the purpose of identifying when the controls do not follow pre-determined quality control rules. Devise a course of action to identify the cause of any discrepancies.

118. Solve case studies given in class with patient results.

Topic: Clinical Chemistry Mathematics

119. Calculate molarity, normality, dilutions, conversions from mg% to mEq/L and from mEq/L to mg%, conversions from one concentration to another, osmolality from the glucose, urea nitrogen, sodium, and values using Beer's Law.

120. Solve word problems involving all the calculations in #1.

121. Make a dilution from a concentrated stock solution correctly.

122. Analyze calculated osmolality vs. measured osmolality to determine correlation and possible cause when there is not correlation.

123. Calculate the volume of a concentrated solution that is required to make a known volume of a less concentrated solution.

124. Calculate the Osmolal Gap and make clinical correlations with the results obtained.

Topic: Bio-Chemical Aspects of Pregnancy

125. Describe the bio-chemical changes which occur in normal pregnancy and explain principles of methodology used in testing for human gonadotropin, estriol and alpha-fetoprotein. Clinically correlate the results of testing to health or disease.

126. Solve case studies given in class from patient results for the stage of pregnancy, viability of the fetus, or possible pathology.

127. Assess all quality control values for discrepancies in meeting rules for controls. Develop a plan to identify the cause for the discrepancy.

128. Research methods to identify the best and most cost effective methods for pregnancy testing.

129. Describe the methods available at the local drug store for pregnancy testing and relate why the results from these tests may not be the best assessment of pregnancy.

130. Describe substances or circumstances which may cause a false positive or negative in pregnancy testing methods.

Topic: Tumor Markers

131. Describe the various tumor markers (prostate-specific antigen, enzymes, CEA, neuron-specific enolase, serotonin etc.) and clinically correlate positive tests with pathological conditions or health.

132. Solve case studies given in class on patients with abnormal tumor marker results.

133. Explain the principles of the methods used to test for tumor markers. Relate why monoclonal antibodies make the methods more specific.

134. Describe growth-promoting oncogenes and their relationship to cancer. Explain the philosophy used in today's medicine for the best chance of a cure for cancer.

135. Explain the staging of cancer and the use of the PSA test in this process.

136. Describe how enzymes and hormones may be used as tumor markers.

137. Assess the need for future testing in making a diagnosis of cancer and relate which tests would be especially useful in this process.

138. Explain the usefulness of using carbohydrate markers in the diagnosis of breast, ovarian, and endometrial carcinoma. This would involve the following: CA 15-3, CA 125, CA 549, CA 27.29, and MCA.

Topic: Clinical Chemistry Problem Solving

139. Analyze instrument data to identify a function problem and devise a course of action to solve the instrument malfunction.

140. Analyze the workflow in a clinical chemistry department or a toxicology lab and devise a plan to improve the turn-around time by improving the workflow in the department.

141. Interpret quality control results that do not meet the quality control rules, devise a plan to correct these controls, and explain the method of implementation for this plan to the class.

142. Examine a personnel problem in the clinical chemistry department, and devise a plan to solve the problem. Sample problems will be assigned in class.

143. Devise a plan to research a new method for performing one of the chemistry tests. Explain how you would investigate the various methods, and how you would select the best method.

144. Present a clinical chemistry problem to the class and explain how you would successfully solve the problem.

Topic: Student Assigned Case Presentations

145. Present three case studies (made up by the student) on three assigned disease topics. Present to the class along with a typed paragraph on each case. Demonstrate a verbal working knowledge of the area in chemistry covered by the case and be able to answer questions on the case asked by the other students. Clinically correlate test results on the cases with disease or health. Discuss the need for future tests and name tests which may be helpful in confirming a diagnosis.

Project an image of professionalism including appearance, dress, and confidence while presenting the case studies.

Show respect for self and others while presenting the case studies.

Communicate effectively in English to the class while presenting the case studies.

Topic: Thyroid Function

146. Describe the feedback system that regulates the thyroid function. Explain the ***anatomy & physiology*** of the thyroid gland.

147. Explain the thyroid hormones, their metabolism, and their regulation.

148. Clinically correlate hormone test results with hyperthyroidism, hypothyroidism, and euthyroidism.

149. Explain and run thyroid function tests. Interpret quality control results on these tests, and analyze discrepancies when they exist. Devise a plan to correct discrepancies.

150. Describe where the thyroid is located in the body and its relation to the parathyroid glands.

151. Explain the diseases that affect the thyroid.

Topic: Hemoglobin and Porphyrins

152. Discuss the structure and function of hemoglobin with regard to biochemical composition, physiology and clinical significance.

153. Describe the four thatassemias to include causes and clinically correlate lab tests with each.

154. Discuss the “hereditary persistence of hemoglobin F.”

155. Explain the following terms:

- Porphyrin
- Porphobilinogen
- Porphyria

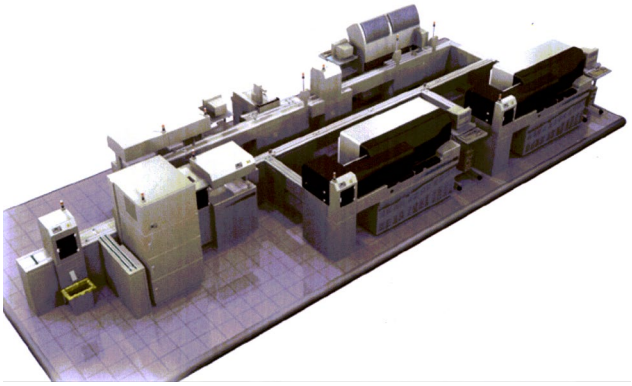
156. Write the biosynthetic pathway of heme and discuss the physiological functions of heme.

157. Explain the effects of lead toxicity on the heme biosynthetic pathway.

158. Explain lab tests used in the diagnosis of porphyrin disorders and clinically correlate the results. Describe possible interferences in each.

159. Describe the symptoms found in the different porphyrias and the abnormal test results in each.

MT 403 Clinical Chemistry



Instructor: Abigail L. Blosser, B.S., MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, question and answer

Goal: Education of the student in clinical chemistry so that they may function as an entry level scientist in the clinical chemistry laboratory.

Pre-requisite Courses: Sixteen semester hours of chemistry and biology, one course in biochemistry or organic chemistry, one college level math course, and three years of college with the guarantee of a B.S. degree at completion of the clinical year

Textbook:

Bishop, Michael L.,, et al. Clinical Chemistry*: Principles, Techniques, and Correlations*. Ninth edition. Jones & Bartlett Learning, 2022. ISBN 9781284238860

Other References:

Bishop, Michael, Edward Fody, and Larry Schoeff. Clinical Chemistry. 8th ed. N.p.: n.p., 2017.

Henry's Clinical Diagnosis and Management by Laboratory Methods, by Richard A McPherson and Matthew R. Pincus, 2017

Keren, David F. Protein Electrophoresis in Clinical Diagnosis. 1st ed. N.p.: American Society of Clinical Pathologists, 2012.

Detrick, Barbara, John L. Schmitz, and Robert G. Hamilton. Manual of Molecular and Clinical Laboratory Immunolgy. 8th ed. N.p.: ASM, 2016. Print.

Instructions: Bring texts to class every day.

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
6/16/26 6/18/26	I. Chemistry Lab Principles (Instrumentation and Safety in the Lab) a. Pipets (volumetric vs. serological) b. Units of measurement/Metric System Analytical Procedures & Instrumentation a. Photometry i. Beer's Law ii. Components of spectrophotometers iii. Flame photometry iv. Atomic absorption b. Light Emission & Scattering Techniques i. Luminescence ii. Fluorescence and flow cytometry iii. Fluorescence polarization iv. Nephelometry v. Turbidimetry vi. Chemiluminescence c. Electrochemistry d. Osmometry e. Chromatography f. Radioactivity g. Immunochemical Techniques h. pH Meter and trouble shooting i. Nucleic acid techniques j. Automation in the clinical laboratory k. Electrophoresis Statistics/Problem Solving/Cases (review from Orientation) Evaluation of Methods, Informatics c. Fundamental concepts i. Standard deviation and Gaussian Distribution (%values in +-1SD, +-2SD, +-3SD) ii. Mean, Median, Mode iii. Levey, Jennings QC charts iv. Coefficient of variation v. Variance vi. Accuracy & Reproducibility vii. Reference values/ranges viii. Quality assurance ix. Establish reference values	Chapter 1-5 & 29
6/23/26 6/25/26	II. Proteins and Amino Acids a. Metabolism & Synthesis & Function b. Methods c. Clinical Correlation d. Individual proteins i. Albumin	Chapter 6

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:

ii. Globulin
iii. Ceruloplasmin, haptoglobin etc.
e. Proteins in other body fluids

6/26/26 – 7/2/26 — Chapter 8 & 20

III. Enzymes
a. Nomenclature
b. Kinetics-Michaelis-Menten Curve
c. Function
d. Methodology and clinical correlation
i. AST
ii. ALT
iii. CK
iv. Aldolase
v. LD – Isomeric Forms
vi. Alkaline Phosphatase
vii. Gamma-Glutamyltransferase
viii. Amylase
ix. Lipase
x. Cholinesterase
xi. Acid Phosphatase
xii. Cardiac function tests
1. Troponin
2. Myoglobin
3. BNP
4. CRP (C-reactive protein)
5. CK and Isoenzymes
xiii. Other tests for prostate
1. PSA, Prostate Specific Antigen

7/16/26 — Chapter 9

IV. Carbohydrates
a. Glucose
i. Factors to consider for glucose testing
1. Metabolism of carbohydrates
2. Pre-analytical, analytical, post-analytical components
3. Methodology
4. Clinical correlation
ii. Diabetes Mellitus
1. Glucose tolerance curves & criteria for diagnosis
2. Other tests for monitoring diabetes mellitus
a. Glycohemoglobins
iii. Ketone bodies
iv. Other tolerance tests
b. Glycogen Storage Disease
c. Lactate and Pyruvate

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
7/16/26	**Exam 1**	
7/21/26 7/23/26	V. Lipids, Lipoproteins, and Apolipoproteins a. Definitions and properties b. Cholesterol (total, LDL, and HDL) and fatty acid c. Prostaglandins and triglycerides (glycerol esters) d. Lipoproteins and apolipoproteins e. Hyperlipidemia causes and coronary heart disease f. Lipoprotein disorders g. Measuring lipids and lipoproteins h. Analytical and physiological variations in measurements i. Apolipoprotein methodology	Chapter 10
7/28/26	VI. Vitamins a. Fat vs. Water soluble b. Dietary requirements	Chapter 27
7/29/26	VII. Endocrinology a. Anatomy & Physiology of glands i. Pituitary ii. Ovary iii. Testis iv. Placenta v. Pancreas vi. Adrenals vii. Pineal viii. Hypothalamus b. Action and control of hormone secretion c. Protein hormones i. Insulin etc. d. Anterior pituitary hormones i. GH ii. ACTH iii. Endorphins iv. LH v. FSH vi. TSH e. Steroid hormones f. Adrenocortical steroids i. Cortisol ii. Aldosterone	Chapter 13, 15, 16 & 17

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:

iii. 11-Deoxycortisol
iv. Corticosteroids
g. Renin and angiotensins
h. Androgens, Testosterone, Progesterone, Estrogens
i. Catecholamines and serotonin

8/4/26 **Exam 2**

8/6/26
8/13/26 VIII. Electrolytes and Other Topics — Chapter 11

a. Sodium
b. Potassium
c. Chloride
d. Bicarbonate
e. Total CO_2
f. Methods and clinical correlation
g. Plasma and urine osmolality
h. Point of care testing
i. Fe
j. Cu
k. Sweat test and cystic fibrosis
l. Wilson's Disease

8/18/26 & 8/20/26 IX. Blood Gasses and pH — Chapter 12

a. Anatomy and physiology of the lungs
b. Physical principles
c. Buffer systems
d. Chloride
e. Acid-base regulation
f. Metabolic acidosis
g. Metabolic alkalosis
h. Respiratory acidosis
i. Respiratory alkalosis
j. Methodology
k. Clinical correlation

3/10/26 X. Renal Function (Non-protein Nitrogen Metabolites) — Chapter 7 & 21

a. Renal function tests
b. Non-protein nitrogen compounds
i. Urea
ii. Creatinine and Creatine
iii. Creatinine clearance
iv. Uric acid
c. Methodology
d. Clinical correlation
e. Tubular and glomerular diseases

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
	f. Anatomy and physiology of the kidney	
8/25/26	**Exam 3**	
8/27/26	XI. Thyroid and Parathyroid Function a. Anatomy and physiology of the parathyroids b. Calcitonin c. Thyroid hormones and regulation d. Clinical correlation – Disease + Test Results i. Hypothyroidism ii. Hyperthyroidism iii. Euthyroid e. Methodology f. Calcium and phosphorus metabolism i. Hyperparathyroidism ii. Hypoparathyroidism g. Parathyroid hormone h. Anatomy and physiology of the thyroid gland i. Feedback system between Pituitary, Hypothalamus, and Thyroid 1. Primary vs. Secondary hypothyroidism and hyperthyroidism	Chapter 14 & 18
8/31/26	XII. Therapeutic Drug Monitoring a. Specific drug groups i. Antiepileptic drugs ii. Cardioactive drugs iii. Bronchodilators iv. Antibiotics v. Antipsychotic drugs vi. Anti-depressants vii. Neuroleptic drugs viii. Antineoplastic drugs ix. Immunosuppressants	Chapter 25
9/2/26 9/8/26	XIII. Toxicology a. Methodology b. Clinical correlation c. Instruments	Chapter 26 & 27
9/10/26	**Exam 4**	
9/15/26	XIV. Bilirubin Metabolism a. Methods b. Clinical correlation (liver physiology and	Chapter 19

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
	anatomy) i. Pre-hepatic jaundice ii. Hepatic jaundice iii. Post-hepatic jaundice	
9/17/26	XV. Gastric, Pancreatic, Intestinal Function a. Gastrointestinal hormones b. Gastric function tests i. Gastric analysis ii. Total titratable acidity iii. Other gastric tests c. Pancreas function d. Sweat ulcer e. Peptic ulcer f. Zollinger-Ellison Syndrome g. Anatomy and physiology of the stomach, pancreas intestine	Chapter 22
9/22/26	XVI. Chemistry Mathematics a. Molarity b. Normality c. MEq/L conversion to mg% d. Dilutions e. Other problems	Chapter 1
9/24/26	Review	
9/29/26	**Exam 5**	
10/1/26 & 10/6/26	XVII. Tumor Markers and Pregnancy a. Bio-chemical aspects of pregnancy b. Testing the pregnant patient i. Human Chorionic Gonadotropin (hCG) ii. Alpha-Fetoprotein iii. Testing for neural tube defects iv. Testing for fetal lung maturity v. Foam test vi. Other tests	Chapter 23, 24 & 28
10/8/26	XVIII. Hemoglobin, Porphyrins, Disorders of Porphyrin, Metabolism a. Hemoglobin b. Porphyrin and heme chemistry c. Primary porphyrin disorders d. Lab diagnosis of porphyria e. Analytical methods	Chapter 6

CLINICAL CHEMISTRY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
10/13/26	***Review & Student Presentation of Assigned Diseases***	
10/15/26	**Final Exam**	

Section 16

Rockingham Memorial Hospital
School of Medical Laboratory Science

BACTERIOLOGY/MICROBIOLOGY OBJECTIVES

(Updated 12/10/21)

The student will, at the completion of the lectures, reading assignments, and verbal instructions on bacteriology and virology by attaining a minimum of 70% on a written or oral exam:

CLASSIFICATION

1. Describe microbial classification and accurately apply the rules of scientific nomenclature for bacterial names

2. Describe how the bacterial genome is organized including the bacterial chromosome, plasmids and transposable elements

3. Discuss the mechanisms by which bacteria physically exchange DNA including transformation, transduction and conjugation

4. Describe the cell walls of both gram positive and gram-negative bacteria, including the gram stain with each type, and give examples of each type

HOST-PARASITE INTERACTIONS

5. Describe how normal flora, physical and chemical barriers protect the host from infectious agents

6. Differentiate the characteristics of the humoral from the cell-mediated immune response

7. Differentiate the mechanisms of infections caused by true pathogens from those caused by opportunistic pathogens

8. Discuss the conditions that must be present or events that must occur for a microorganism to cause disease

9. Define
    - Reservoir
    - Vector
    - Fomite
    - Nosocomial infection
    - Zoonoses

SAFETY

10. Explain the methods of sterilization and disinfection

11. Explain and apply risk management and risk assessment in the microbiology laboratory

12. Differentiate the functions and purposes of a disinfectant and an antiseptic

13. Give the mechanism of action for each type of chemical agent commonly used in antiseptics and disinfectants

14. Differentiate the design, function and use of three levels of Biological Safety Cabinets

15. Define
    - Bacteriostatic
    - Disinfection
    - Sterilization
    - Bactericidal

MICROSCOPY AND STAINING

16. Describe and apply principles of operation for the compound microscope, phase contrast microscope, fluorescent microscope and electron microscope. Solve problems that may arise during the utilization of the various microscopes

17. Describe and perform different types of stains; including differential stains utilized in the microbiology laboratory

18. Analyze and solve problems that may arise during staining procedures

19. Given a list of stains commonly used in the clinical laboratory, select the stain for determining whether a microbe is a bacterium, fungus, mycobacterium or viral inclusion

20. Given a gram stain smear of infected material, describe the local material, contaminating material, purulence and associated microorganisms

21. Explain the application of quality control and quality improvement activities to the results of the direct microscopic examination and culture

22. Explain the use of stains routinely used in the microbiology laboratory

IMMUNOSEROLOGY

23. Describe the principles and applications of the serologic methods discussed

24. Discuss the purpose for immunologic testing and clinically correlate the results with the appropriate pathological condition. Solve any problems that may arise with testing

25. Describe and differentiate the immunoassay methods described in class

26. Verify the testing results and quality control for all reactions

27. Interpret case studies and make judgments concerning the reactions

MOLECULAR TECHNIQUES and FUNDAMENTALS OF MOLECULAR BIOLOGY

28. Discuss and explain nucleic acid hybridization and the fundamentals of molecular biology. Describe the principles for molecular antigen detection methods used in the microbiology laboratory. Explain recombinant DNA technology and gene cloning

29. Describe the colonial applications of direct antigen detection methods

30. Describe the clinical applications of amplification systems and probe technology in the microbiology laboratory. Explain and interpret the following molecular biology techniques: Southern blot and Northern blot

ANTIMICROBIAL AGENTS AND SUSCEPTIBILITY TESTING

31. Correlate the basic structure of microorganisms and the specific functions of individual components with the actions of antimicrobial agents

32. List the major sites of action for major classifications of antimicrobial agents

33. List examples of antimicrobial agents that affect structural integrity; describe how beta lactam agents result in antibacterial activity

34. List the antimicrobials whose primary mechanism is interference with metabolic functions, including DNA syntheses, RNA syntheses and folic acid metabolism

35. Describe the general considerations that are involved in selecting an appropriate antimicrobial agent to treat an infection

36. Evaluate the responsibility of the laboratory staff in antimicrobial susceptibility testing

37. Compare the clinical effectiveness and mode of action of the more common antimicrobial agents

38. Describe the mechanism of action of the more common antimicrobial agents

39. Differentiate intrinsic and non-intrinsic bacterial resistance to antimicrobial therapy

40. List and describe five biochemical mechanisms of bacterial resistance

41. Discuss the principle of disk agar diffusion tests including the determination of susceptibility

42. Assess the importance of factors such as inoculum density, composition and depth of agar, temperature of incubation and potency of disks in determining inhibition zone sizes

43. Describe the agar dilution and the broth dilution susceptibility tests

44. Design a quality control model as to when you would perform quality control for antimicrobial susceptibility procedures

45. Explain the use of MIC's and the purpose for routine susceptibility testing

46. Compare the advantages and disadvantages of automated systems for antimicrobial susceptibility testing

47. Discuss the quality control aspects of antimicrobial susceptibility testing

AUTOMATION AND INSTRUMENTATION

48. Describe and utilize commercial biochemical identification systems such as API 20E, VITEK, Microscan System etc

49. Identify and solve problems with these commercial systems

50. Discuss the principle and purpose of
    - rapid conventional tests
    - miniaturized microbiologic methods
    - instrumentation commonly used in microbiology laboratories
    - automated detection systems, including BacTalert

SPECIMEN COLLECTION AND PROCESSING

51. Define the atmospheric requirements of obligate aerobes, microaerophiles, facultative anaerobes, obligate anaerobes and capnophilic bacteria

52. Demonstrate knowledge of mechanisms for maintaining organism viability relating to preservation, storage and transport of specimens

53. Given a specific specimen source, be able to identify the preferred specimen collection method, transportation of the specimen, and the procedures for culturing the specimen in the lab

54. Explain the time and storage requirements for specimens when cultures cannot be processed immediately

55. Discuss and perform collection of specimens, and solve problems that may arise during this collection

56. Assess the appropriate times for the collection and incubation times of blood cultures

57. Explain and perform the processing and inoculation procedure for CSF

58. Describe the methods for culturing urine and relate the most common causes of UTI's

MICROBIOLOGIC MEDIA

59. Explain the purposes of microbiology media, and discuss the conditions provided by Microbiology media that enhance bacterial growth

60. List the nutritional and environmental requirements for bacterial growth, and define the categories of media used for culturing bacteria

61. Discuss and apply the purpose, principle, interpretation, ingredients and preparation for each media discussed

62. Identify each phase of the bacterial growth cycle

63. Differentiate the three basic types of media and provide examples of each type

64. Recall chemicals, dyes, or antibiotics present in the media, or special procedures required for the media

65. Describe how growth on blood, chocolate and MacConkey agars is used in the preliminary identification of organisms

66. Describe how gross colony characteristics are used in the presumptive identification of microorganism

67. Given a specific organism, describe its colonial morphology on routine agar

68. Given a specific bacterium, select the routine primary culture media for that organism and any media used for selection, differentiation or identification

IDENTIFICATION OF BACTERIA

69. Describe the principle of the test and state the quality control organisms that are used for each of the biochemical tests discussed in class.

70. Assess quality control results for a given biochemical test and analyze unexpected results

GENERAL OBJECTIVES FOR ALL ORGANISMS

71. Describe the general characteristics, micro and macroscopically, including gram stain and biochemical reactions, etiology, and appearance on selective and non selective media

72. Discuss the virulence factors, if applicable, and correlate clinically organism to disease

73. Give the signs and symptoms of clinical infections and explain how infection is established

74. State and discuss the principle and purpose of differential tests, including routine and special media and serological tests, used for presumptive and definitive identification

75. Select proper atmospheric, nutritional requirements and environmental conditions for culture of each bacterium

76. Differentiate clinically significant species from non-significant species and methods to control the spread of the organism, if applicable

77. Discuss the proper methods of specimen collection and handling, including common body sites and the acceptability of specimens. Explain when additional testing is needed to identify an organism and select the appropriate test to make that identification

78. State the appropriate antimicrobial agent and susceptibility testing for this organism

79. Design a flow chart for identification of this genus (genera) and alternative methods of testing

80. Recognize discrepancies in testing or quality control, and develop a course of action to resolve these problems.

81. Describe identification of these organisms by molecular or other methods

82. Determine the validity of all tests, and solve case studies by stating the correct diagnosis with the patient's physical characteristics and the lab results are given

STAPHYLOCOCCI

83. Describe the cause for the beta hemolysis around colonies of *S. aureus* on sheep blood agar

84. Correlate coagulase test results to the identification of staphylococci

85. Explain the etiology behind this statement, "*S. epidermidis* is a major cause of infection associated with indwelling devices"

86. Discuss methods /tests to differentiate micrococci and staphylococci and evaluate the results of lysostaphin and microdase testing

STREPTOCOCCI

87. Explain the use of a bacitracin disc in identifying beta hemolytic strep

88. Correlate Lancefield Groupings with specific *Streptococcus* species. Explain the use of optochin susceptibility and bile solubility in differentiating organisms.

89. Explain the significance of the "viridans streptococci"

90. Name the nutritionally deficient gram positive organisms. Recognize when they are present in a blood culture and describe how to isolate them on solid medium.

GRAM POSITIVE BACILLI

BACILLUS

91. Describe the organism in this category that is utilized in the testing of sterilizers

92. Solve case studies that describe the transmission *of B. anthracis* to include the chief animal reservoirs

93. Demonstrate the correct safety precautions when working with cultures of *B. anthracis*

94. Identify the various forms and discuss ways to prevent anthrax

95. Identify *B. anthracis* from laboratory testing, solve any problems that may arise and clinically correlate the results

CORYNEBACTERIUM

96. Evaluate the use and importance of the Babes-Ernst stain

ERYSIPELOTHRIX

97. Differentiate *Erysipelothrix rhusiopathiae* from other non-spore forming gram-positive bacilli

LISTERIA

98. Interpret two methods of motility testing for Listeria

99. Compare and contrast characteristics to differentiate Listeria from Streptococcus

ENTEROBACTERIACEAE

100. Describe the primary habitats of the Enterobacteriaceae and relate this to the transmission of disease

101. Outline measures to assure personal safety when working with enteric pathogens

102. Describe the time and/or stage, and the number of specimens collected for stool cultures

103. List the most common members of Enterobacteriaceae that cause urinary tract infections

104. Name and describe the surface antigens associated with the Enterobacteriaceae

105. Given the reactions of biochemical testing and colonial appearance, place an unknown organism in its proper tribe or genus

ESCHERICHIA

106. List the five principle types of enteropathogenic *E. coli* and indicate the type seen and cultured for in the United States

SHIGELLA

107. Name the four species indicating the most common and the most severe in terms of clinical infection

OTHER GRAM NEGATIVE BACTERIA

PSEUDOMONAS

108. Name the different pigments and their colors produced by *Pseudomonas aeruginosa*.

109. Name the extra cellular enzymes produced by *P. aeruginosa* that help promote and contribute to virulence and tissue destruction

110. Name the organism commonly isolated from cystic fibrosis patients

111. List the three *Pseudomonas* species that may produce fluorescent pigments

VIBRIO

112. Outline measures to assure personal safety when working with Vibrionaceae discussed in lecture

113. Discuss methods to differentiate the strains of *Vibrio* which cause cholera from other diarrhea causing agents

AEROMONAS & PLESIOMONAS

HAEMOPHILUS & HACEK ORGANISMS

114. Solve case studies and written problems where characteristics of *Haemophilus* are given and the correct treatment and pathological condition must be selected

115. Evaluate hemolysis and X and V factor reactions in the identification of *Haemophilus* species

116. Based on biochemical reactions, distinguish between *Aggregatibacter aphrophilus* , *Aggregatibacter actinomycetemcomitans, Cardiobacterium hominis, Eikenella corrodens* and *Kingella* spp. Correlate these results with the clinical picture

NEISSERIA

117. Describe the primary sites of colonization of *Neisseria meningitidis* in asymptomatic carriers and relate to the transmission of the organism

118. Assess the importance of the appearance of gram-negative diplococci in the gram stain of the urethral discharge of a male patient and compare that to the appearance of gram-negative diplococci from the smear of the anorectal area or female endocervix

119. Make judgments after assessing testing results and other data as to the need for future testing or evaluation of the patient

120. Discuss some advantages and drawbacks of non-culture detection methods for *Neisseria gonorrhoeae*

CAMPYLOBACTER, HELICOBACTER & OTHERS

121. Describe the clinical picture associated with gastrointestinal infection by *Campylobacter*

122. Differentiate *Campylobacter jejuni* from *Campylobacter coli* using biochemical test results

123. Describe specimens and non-culture methods used to identify *Helicobacter pylori*

LEGIONELLA

124. Solve case studies that give patient physical characteristics and laboratory testing results by giving the correct diagnosis for *Legionella*

GRAM NEGATIVE COCCOBACILLI

PASTEURELLA

125. Name the species of *Pasteurella* that cause human disease

126. Describe the morphology and characteristics of *Pasteurella multocida*

127. Identify the odor emitted from a *P. multocida* culture

128. Describe *P. multocida* colony types

129. Discuss the clinical infection of *P. multocida*, including its source of isolation and mode of transmission

130. Discuss the treatment of *P. multocida*

FRANCISELLA

131. Explain the transmission of *Francisella*, the types of infection caused by this organism and explain the most common and the most severe cases

132. Describe precautions that should be taken when working with *Francisella*

BORDETELLA

BRUCELLA

133. Explain all the species of *Brucella* and include the animal(s) associated with each

134. Describe the mode of transmission of *Brucella*, including the likely candidates for infection and methods of disease prevention

135. Differentiate the four species of *Brucella* which are human pathogens based on growth in dyes, H2S and urease results.

SPIROCHETES

136. Describe the primary, secondary and tertiary clinical manifestations of syphilis
137. Describe the arthropod vector for *Borrelia burgdorferi*

138. Name the confirmation test used in the diagnosis of Lyme disease

CHLAMYDIAE

139. Relate the reproductive cycle of the Chlamydiae to infectivity

140. Select and evaluate the use and the benefits of the various types of media and cell lines used in the isolation of the *Mycoplasma*, Chlamydiae and Rickettsiae

141. Compare and contrast characteristics of the *Mycoplasma*, Chlamydiae and Rickettsiae organisms discussed in lecture to the characteristics of viruses and bacteria. Clinically correlate to disease

<u>MYCOPLASMA</u>

142. Relate the reproductive cycle of the *Mycoplasma* to infectivity

143. Compare and contrast characteristics of the *Mycoplasma* to the characteristics of viruses and bacteria. Clinically correlate test results to disease or health

RICKETTSIAE

144. Compare and contrast characteristics of the Rickettsiae to the characteristics of viruses and bacteria

145. Given a specific rickettsial disease, give the causative agent and mode of transmission to humans

ANAEROBES

146. Discuss the various classification types of anaerobes. Identify the environmental requirements of each. Discuss the types of infections caused by anaerobes. Contrast anaerobic infections with infections caused by aerobic organisms

147. Describe acceptable methods for performing anaerobic antimicrobial susceptibility tests. Discuss methods of treatment for anaerobic infections

148. List the types of cultures that are not acceptable for anaerobe culture. List acceptable specimens

149. Recall the content of the inoculating needles/loops used to work with anaerobes

150. Name several methods to obtain anaerobic conditions

151. Recall the indicator used in determining anaerobic conditions

152. Discuss the use of the catalyst, including what they consist of and the way to rejuvenate or reactivate the catalyst

153. Discuss the reasons for not isolating anaerobes from specimens and the group of anaerobes most often isolated

154. Monitor, evaluate and resolve any problems arising from environmental and growth requirements required for the anaerobes, obligate anaerobes and aero tolerant anaerobes

BACTEROIDES

155. List the most frequently isolated species of the *Bacteroides fragilis* group

PREVOTELLA

PORPHYROMONAS

156. Describe the characteristics of the pigmenting *Bacteroides, Prevotella*, and *Porphyromonas*

FUSOBACTERIUM

157. State the *Fusobacterium* species that gives a fried egg appearance on blood agar, and that gives a bread crumb appearance on blood agar

158. Recall the species that fluoresce a brick red, coral, or chartreuse

PROPIONIBACTERIUM

159. Recall the major acid produced in fermentation of glucose by *Propionibacterium*

ACTINOMYCES

160. Name the most common and important species of *Actinomyces*

161. Describe "sulfur granules" including macroscopically and microscopically, and where they might be found

PEPTOCOCCUS

PEPTOSTREPTOCOCCUS

162. Recall the *Peptostreptococcus* species that is most susceptible to SPS

163. Name the *Peptostreptococcus* species that is indole positive

VEILLONELLA

CLOSTRIDIUM

164. List the five major groups of *Clostridium*

165. Recall the way to enhance sporulation for some members of *Clostridium*

166. Discuss three types of infections of *C. botulinum* and its effect on the body

167. List the three most common species of gas gangrene

168. Recall two factors that are important in the spread of gas gangrene

169. Discuss the reason for *C. perfringens* being called the "gas bacillus"

MYCOBACTERIA

170. Correlate, interpret and apply the cultural characteristics, gram stain morphology, rate of growth, photo reactivity (pigmentation) and biochemical reactions to identify the *Mycobacteria* discussed in lecture

171. Outline measures to assure personal safety when working with *Mycobacteria* discussed in lecture

172. Explain why clinical specimens for mycobacterial isolation require digestion and decontamination procedures

173. Define
    - Nonphotochromogen
    - Photochromogen
    - Scotochromogen

174. Name and describe the disease caused by the noncultivatable species of *Mycobacteria*

INFECTIONS BY BODY SITE

175. List the predominant flora of various body sites in a healthy individual

176. Discuss the bacteria isolated from the cerebrospinal fluid and the age groups affected by each

177. Discuss the two major causes of conjunctivitis and three causes of acute otitis media

178. Explain the three organisms associated with otitis externa and the four organisms frequently isolated from wound cultures

179. Discuss the organisms that are considered pathogenic to the lower and upper respiratory tracts, and the method used for ensuring that an adequate sputum specimen has been submitted for culture

180. Explain the pathogens that cause GI tract pathology, give examples, discuss, interpret and solve problems when isolating these organisms

181. Discuss genital tract pathogens and culture media useful in the isolation of these pathogens

182. Given a specific specimen source, be able to identify the preferred specimen collection method, transportation of the specimen, and the procedures for culturing the specimen in the lab

183. Given the clinical picture presented and the symptoms, associate the most probable organisms that cause disease in a specific body site

QUALITY MANAGEMENT

184. Explain, interpret and apply elements of quality management in the microbiology lab to include administering the program, monitoring completion of components, schedule of meetings held and corrective action taken. The program should include performance standards of biochemical differential media for bacteria, mycology etc

INFECTION CONTROL

185. Define nosocomial and community acquired infections

186. List the services or specialties of a hospital with the highest rate of infections and the services with the lowest rate

187. Describe the four ways infections are spread in a hospital and the most important way to prevent transmission

188. Explain the most frequent nosocomial infection syndrome along with the pathogen most often isolated

189. Discuss the four most common types of hospital-acquired infections with approximate percentages

190. Describe three factors, which may influence the development of a nosocomial infection and the financial effects of nosocomial infections

191. Explain the purpose of the Infection Control Committee and the person/department who is responsible for tracking down an outbreak of infection within a hospital

192. Explain why some nosocomial rates may be falsely decreased and the national nosocomial infection statistics

193. Describe and discuss the role of the microbiology laboratory in a successful infection control program

BIOTERROR

194. Explain the Laboratory Response Network and the function of each level in the event of a bioterror incident

195. List the Select Agents which laboratories are required to report to DHHS and CDC when recovered

196. Describe what is meant by, “Rule out or refer”

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VIROLOGY OBJECTIVES

The MLS student will at the completion of the virology lectures and reading assignments with an accuracy of 70% on an exam:

1. Explain the characteristics of viruses and differentiate them from bacteria.

2. Summarize how viruses multiply.

3. Perform the proper procedures for collection and transport of viral specimens.

4. Recognize the appropriate specimen for maximum recovery of the suspected viral agent.

5. Explain how each of the viruses discussed in class are transmitted and acquired.

6. Describe the types of infection that each virus produces.

7. Explain the most effective method of making a laboratory diagnosis for each of the viruses discussed in class.

8. Discuss the general principles and processing based on specimen type and based on the specific viruses.

9. Describe how cell-culture is utilized to identify viruses. Define CPE and describe characteristic CPE of the viruses discussed in lecture.

10. Describe the various virus detection methods to include the following:
    - Cytology and histology
    - Electron microscopy
    - Immunodiagnostic
    - Enzyme-linked virus-inducible system
    - Molecular detection
    - Cell culture

11. Interpret virology test results and clinically correlate them to disease.

12. Explain the preservation and storage of viruses.

13. Explain the ways that viral infections may be prevented.

14. Interpret quality control results seen on viral testing.

15. Analyze case studies of patients with viral infections and determine the appropriate disease and recommend the need for future testing to establish a diagnosis or rule out a diagnosis.

16. Analyze problems with testing viral specimens such as unexpected results and formulate a resolution to the problem.

17. Evaluate methods that are used in the treatment of viral disease.

SRMH School of Medical Laboratory Science

PARASITOLOGY OBJECTIVES

The student will at the completion of the lectures, reading assignments, and verbal instructions on parasitology by attaining a minimum of 70% on a written or oral exam:

Introduction/Specimen Collection

1. Assess the appropriateness of specimens, specimen collection, preservation, storage and processing for isolation of fecal, blood or tissue parasites.

2. Evaluate and resolve any problems arising from specimens, specimen collection, storage, and processing which would affect the recovery of organisms.

3. Correlate the consistency of a fecal specimen with the presence of cysts or trophozoites.

4. Explain, interpret and apply data from wet mount, permanent smears and other stained slides discussed in lecture to the identification of organisms.

5. Interpret, correlate and apply data from the entero-test, Giardia EIA and cellophane tape test to clinical infection.

6. Evaluate and determine alternate methods used to concentrate fecal specimens.

7. Outline an appropriate QA program to be utilized in a Parasitology laboratory.

8. Outline measures to assure personal safety when working with potentially pathogenic specimens in the Parasitology laboratory.

9. Design a procedure or schema outlining steps for identification of parasites in fecal, blood, tissue and other biological specimens.

10. Recognize and evaluate any discrepancies in testing or quality control and develop an appropriate course of action for its resolution.

Host-Parasite Relationships and Intestinal Protozoa

11. Evaluate laboratory data to establish a new testing procedure for alternate methods for protozoa identification.

12. Given clinical history and data, relate the host/parasite relationship (symbiotic, commensal, mutual, obligate or facultative) to a specific parasitic infection.

13. Clinically correlate testing to infections and pathologic conditions caused by intestinal protozoa discussed in lecture.

14. Identify, correlate and apply the structural characteristics to identify the various stages of intestinal protozoa discussed in lecture.

15. Evaluate the use and the benefits of the various types of testing used in the identification of intestinal protozoa.

16. Evaluate the etiology and clinical manifestations of infections or syndromes caused by the intestinal protozoa discussed in lecture.

17. Assess the appropriateness of specimens for isolation of the intestinal protozoa.

18. Explain and correlate the developmental cycles of the intestinal protozoa and relate to infectivity and transmission.

19. Select and evaluate appropriate therapy in the treatment of infections caused by the intestinal protozoa discussed in lecture.

20. Design a procedure or schema outlining steps for identification of intestinal protozoa discussed in lecture.

21. Recognize any discrepancies in testing or quality control and develop an appropriate course of action for its resolution.

Nematodes, Trematodes and Cestodes

22. Differentiate between the nematodes, trematodes and cestodes.

23. Correlate testing to infections and pathologic conditions caused by members of the nematodes, trematodes and cestodes.

24. Interpret the structural characteristics of ova and worms to identify the nematodes, trematodes and cestodes.

25. Evaluate the use and benefits of the various methods used in the identification of nematodes, trematodes and cestodes.

26. Evaluate the etiology and clinical manifestations of infections or syndromes caused by the nematodes, trematodes and cestodes.

27. Describe the primary habitats and reservoirs for nematodes, trematodes and cestodes and relate the transmission of the organism.

28. Assess the appropriateness of specimens for isolation of the nematodes, trematodes and cestodes.

29. Explain and correlate the developmental cycles (including any intermediate hosts) of the nematodes, trematodes and cestodes.

30. Select and evaluate appropriate therapy in the treatment of infections caused by the nematodes, trematodes and cestodes.

31. Design a procedure or schema outlining steps for identification of nematodes, trematodes and cestodes.

32. Recognize any discrepancies in testing or quality control and develop an appropriate course of action for its resolution.

Plasmodium and Other Blood and Tissue Parasites

33. Correlate testing to infections and pathologic conditions caused by blood and tissue parasites.

34. Identify and apply the structural characteristics to identify the various stages of blood and tissue parasites.

35. Evaluate the use and the benefits of the various types of testing used in the identification of blood and tissue parasites.
36. Evaluate the etiology and clinical manifestations of infections or syndromes caused by the blood and tissue parasites.

37. Asses the appropriateness of specimens for isolation of the blood and tissue parasites.
38. Explain and correlate the developmental cycles (including any intermediate hosts and vectors) of the blood and tissue parasites and relate to infectivity and transmission.

39. Select and evaluate appropriate therapy in the treatment of infections caused by the blood and tissue parasites.

40. Design a procedure or schema outlining steps for identification of blood and tissue parasites.

41. Recognize any discrepancies in testing or quality control and develop an appropriate course of action for its resolution.

Arthropods

42. Correlate identification of arthropods to infections and pathologic conditions.

43. Correlate and apply the morphological characteristics to identify the arthropods.

44. Evaluate the etiology and clinical manifestations of infections or syndromes caused by the arthropods.

45. Explain and correlate the developmental cycles of the arthropods and relate to infectivity and transmission.

46. Correlate and apply the specific genus of arthropods required as an intermediate host for various helminth and protozoan infections.

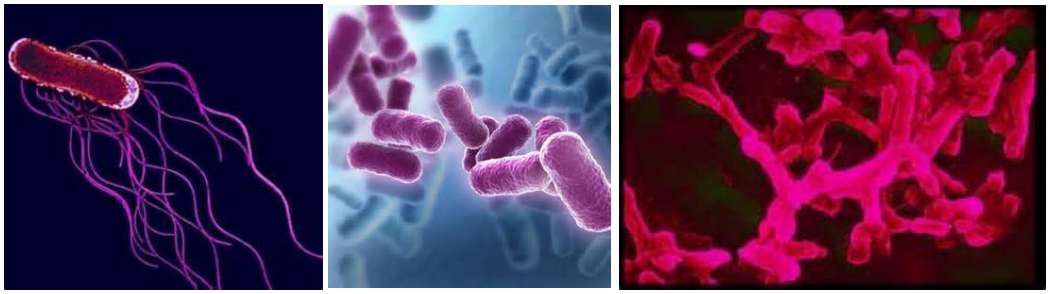
47. Contrast the role of arthropods as intermediate hosts and as transport hosts for various parasites and microorganisms.

48. Design a method of prevention of infestation caused by arthropods.

49. Design a procedure or schema outlining steps for controlling arthropods.

50. Recognize any discrepancies in testing or quality control and develop an appropriate course of action for its resolution.

MT 405 Microbiology



Instructor: Cyndee S. Lowe, M.A., MLS (ASCP)^{CM}
Emileigh Conley, B.S., MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, case studies, prepared slides, laboratory exercises, question and answer

Course Goal: The goal of this course is to educate students in clinically significant bacteria and viruses, as well as microscopy and molecular biology, and to prepare the students to be able to function as an entry-level technologist/scientist in the Bacteriology and Virology departments.

Textbook: *Mahon, Connie R., and Lehman, Donald C. Textbook of Diagnostic Microbiology. Maryland Heights, MO: Saunders Elsevier, 2023, Seventh Edition, ISBN #978-0323829977..*

Other References:

Henry's Clinical Diagnosis and Management by Laboratory Methods 23rd edition, Richard A. McPherson and Matthew R. Pincus, 2017

Bailey & Scott's Diagnostic Microbiology, 14th edition, Forbes, Sahm, and Weissfeld, Mosby-Year Book Inc., 2017

Color Atlas and Textbook of Diagnostic Microbiology 7th edition, Allen, Janda, Koneman, and others, Lippincott, 2016

Manual of Clinical Microbiology, 11th edition, Murray, Baron, and others, ASM Press, 2015

Pre-requisite Courses: 3 years of college with required science courses for entry into Sentara RMH School of Medical Laboratory Science plus guarantee of BS degree upon completion of clinical year

Instructions: Bring texts to class every day.

DATE:		TOPIC:	READING ASSIGNMENT:
6/17/26 & 6/19/26	I.	Introduction a. Purpose of Clinical Microbiology	Chapter 1
	II.	Bacterial Taxonomy, Genetics, Metabolism, and Structure a. Taxonomy b. Structure of bacterial cells c. Cell growth and metabolism d. Bacterial genetics	
6/22/26	III.	Host-Parasite Interactions a. Definitions b. Host factors c. Microbial factors d. Outcomes of infection	Chapter 2
6/24/26	IV.	Laboratory Safety and Control of Microorganisms a. Exposure control plan i. Employees ii. Waste disposal iii. Standard precautions iv. Chemical safety v. Engineering controls vi. Biosafety cabinets vii. Routes of exposure b. CDC biosafety levels c. Sterilization and disinfection	Chapter 4
6/26/26	V.	Specimen Collection and Processing a. Pre-analytic phase i. Specimen collection ii. Specimen preservation iii. Specimen storage b. Analytic phase i. Specimen processing ii. Environmental requirements iii. Direct microscopic examination iv. Specimen work-up c. Post-analytic phase i. Communication with clinicians ii. Communication with epidemiologists	Chapter 6
6/29/26	VI.	Microscopy and Staining a. Goals b. Phase-contrast c. Dark field d. Fluorescent	Chapter 7

DATE:		TOPIC:	READING ASSIGNMENT:
		e. Electron f. Bright field i. Staining techniques ii. Direct examinations iii. QC	
6/30/26 6/30/26 7/8/26 7/9/26	VII.	Bacterial Identification a. Introduction b. Conventional methods c. Immunologic methods d. Molecular methods	Chapters 8, 10 & 11
7/10/26		**Exam 1**	
7/13/26 &	VIII.	Antimicrobial Agents and Susceptibility Testing a. Antibiotic targets and mechanisms of action i. Cell wall synthesis ii. Plasma membrane function iii. mRNA translation/protein synthesis iv. DNA/RNA synthesis v. Other b. Mechanisms of resistance c. Susceptibility testing i. Introduction ii. Traditional methods iii. Automated systems iv. Special methods	Chapter 12 Chapter 13
7/14/26 & 7/15/26		**Disk Diffusion Lab**	
7/17/26	IX.	*Staphylococcus* and *Micrococcus* a. *Staphylococcus* i. *Staphylococcus aureus* ii. Coagulase negative *Staph* b. *Micrococcus*	Chapter 14
7/20/26	X.	*Streptococcus* and *Enterococcus* a. Introduction b. Beta-hemolytic streptococci (Groups A, B, C, F, G) c. *Streptococcus pneumoniae* d. Viridans streptococci e. *Enterococcus*	Chapter 15

DATE:		TOPIC:	READING ASSIGNMENT:
7/22/26		**Gram Positive Cocci Lab**	
7/24/26 7/27/26	XI.	Gram Positive Bacilli a. *Bacillus* b. *Listeria* c. *Corynebacterium* d. *Erysipelothrix* e. *Gardnerella* f. *Lactobacillus*	Chapter 16
7/27/26		**Exam 2**	
7/29/26 7/30/26	XII. XIII.	Identification of Gram Negative Organisms *Enterobacteriaceae* a. General characteristics and tests b. *Escherichia* c. *Shigella* d. *Salmonella* e. *Yersinia* f. *Klebsiella* g. *Enterobacter* h. *Serratia* i. *Hafnia* j. *Pantoea* k. *Proteus* l. *Providencia* m. *Morganella* n. *Citrobacter* o. *Edwardsiella* p. Other species	Chapter 19
8/3/26, 8/4/26, & 8/5/26		***Enterobacteriaceae* Lab**	
8/7/26		**Exam 3**	
8/10/26	XIV.	Oxidase-Postive Gram-Negative Fermenting Bacteria a. *Vibrio* b. *Aeromonas* c. *Plesiomonas* d. *Chromobacterium*	Chapter 20

DATE:		TOPIC:	READING ASSIGNMENT:
8/12/26	XV.	Nonfermentative Gram-Negative Bacteria a. *Acinetobacter* b. *Stenotrophomonas* c. *Pseudomonas* d. *Burkholderia* e. *Shewanella* f. *Ralstonia* g. *Rhizobium* h. *Achromobacter* i. *Alcaligenes* j. *Elizabethkingia* k. *Comamonas* l. *Sphingomonas* m. *Brevundimonas*	Chapter 21
8/14/26	XVI.	HACEK Biological Organisms a. *Haemophilus* b. *Actinobacillus* c. *Cardiobacterium* d. *Eikenella* e. *Kingella*	Chapter 18
8/17/26 8/19/26	**REVIEW** **Exam 4**		
8/21/26 & 8/24/26	XVII.	Miscellaneous Gram-Negative Bacilli and Coccobacilli a. *Capnocytophaga* b. *Pasteurella* c. *Brucella* d. *Franciscella* e. *Legionella* f. *Bordetella* g. *Campylobacter* h. *Arcobacter* i. *Heliobacter* j. *Bartonella* k. *Streptobacillus* l. *Spirillum* m. *Tropheryma*	Chapters 18, 20, and 21
8/26/26 & 8/28/26	XVIII.	Anaerobic Bacteria a. Definition of anaerobe types b. Isolation and collection of anaerobes c. Organism isolation d. *Clostridium* (spore-forming rods)	Chapter 22

DATE:		TOPIC:	READING ASSIGNMENT:
		e. Anaerobic gram-positive (non-spore forming) bacilli i. *Propionibacterium* ii. *Eubacterium* iii. *Actinomyces* iv. *Lactobacillus* v. *Bifidobacterium* vi. *Mobiluncus* f. Anaerobic gram-negative (non-spore forming) bacilli i. *Bacteroides* ii. *Bilophila* iii. *Prevotella* iv. *Porphrymonas* v. *Fusobacterium* g. Anaerobic gram-positive cocci i. *Peptostreptococcus* ii. *Peptoniphilus* iii. *Anaerobius* iv. *Peptococcus* h. Anaerobic gram-negative cocci i. *Veillonella* i. Susceptibility testing	
8/31/26		**Exam 5**	
9/2/26	XIX.	Gram-Negative Cocci a. *Neisseria* b. *Moraxella* c. Nonpathogenic forms	Chapter 17
9/3/26	XX.	Spirochetes a. Introduction b. Morphology i. *Treponema* ii. *Borrelia* iii. *Leptospira*	Chapter 23
9/4/26 9/9/26	XXI.	*Chlamydia, Mycoplasma,* and *Ureaplasma* a. Overview b. Reproduction c. *Chlamydia* d. *Mycoplasma* e. *Ureaplasma*	Chapters 24 & 25

DATE:		TOPIC:	READING ASSIGNMENT:
9/11/26	XXII.	*Rickettsiae* a. *Rickettsia rickettsia* b. *Rickettsia akari* c. *Rickettsia conorii* d. *Rickettsia prowazekii* e. *Rickettsia typhi* f. *Orientia tsutsugamushi* g. *Anaplasma* h. *Ehrlichia* i. Diagnosis j. Treatment k. Q fever i. Pathogenesis, control and treatment	Chapter 24
9/11/26	**Exam 6**		
9/14/26	XXIII.	Mycobacteria a. Collection and processing b. Staining acid-fast bacilli c. Growth requirements d. Identification i. Colony morphology ii. Rate of growth and relation to temperature iii. Pigmentation and photo reactivity iv. Definitive identification e. *Mycobacterium tuberculosis* complex f. Photochromogens g. Scotochromogens h. Non-chromogenic, slow growing i. Rapid growing, *Mycobacteria* j. Antimicrobial treatment k. *Mycobacterium leprae*	Chapter 26
9/16/26	XXIV.	*Actinomycetes* a. *Nocardia* b. *Streptomyces* c. *Actinomadura* d. *Gordonia* e. *Tsukamurella* f. *Rhodococcus*	Chapter 16
9/18/26	**Exam 7**		
		Virology	
9/21/26	XXV.	General Characteristics of Viruses a. Viral structure b. Classification of viruses i. DNA viruses	Chapter 29

ii. RNA viruses
c. Viral replication
d. Laboratory diagnosis of viral infections
i. Specimen collection and transport
ii. Methods of diagnosis
1. Direct detection
2. Nucleic acid based detection
3. Viral isolation
4. Serologic assays

9/23/26 & 9/25/26 XXVI. Viruses that Cause Human Disease
a. Double stranded DNA viruses
i. Adenoviridae
ii. Herpesviridae
iii. Papillomaviridae
iv. Poxviridae
b. Single stranded DNA viruses
i. Parvoviridae
c. Double stranded RNA viruses
i. Reoviridae
d. Single stranded RNA viruses
i. Arenaviridae
ii. Bunyaviridae
iii. Calciviridae
iv. Coronaviridae
v. Filoviridae
vi. Flaviviridae
vii. Orthomyxoviridae
viii. Paramyxoviridae
ix. Picornaviridae
x. Retroviridae
xi. Rhabdoviridae
xii. Togaviridae
e. Hepatitis viruses
i. Hepatitis A virus
ii. Hepatitis B virus
iii. Hepatitis D virus
iv. Hepatitis C virus
v. Other Hepatitis viruses

9/28/26 XXVII. Prions

9/30/26 XXVIII. Antiviral Therapy

10/2/26 **Exam 8**

Parasitology

10/5/26 XXIX. Introduction — Chapter 28

XXX. Specimen Collection and Processing

XXXI. Stool Examination Procedures

XXXII. Additional Techniques for GI Tract Specimens

XXXIII. Blood and Tissue Parasites

XXXIV. Direct Detection and Serology

XXXV. Precautions and Quality Assurance

10/7/26 & 10/9/26

XXXVI. Protozoa
- a. Intestinal Amebae
- b. Tissue Amebae
- c. Ciliates
- d. Intestinal and Urogenital Flagellates
- e. Blood and Tissue Flagellates

10/12/26

XXXVII. Apicomplexa
- a. *Plasmodium*
- b. *Babesia microti*
- c. *Toxoplasma gondii*
- d. Intestinal opportunists

XXXVIII. Microsporidia

10/14/26, 10/16/26 & 10/19/26

XXXIX. Helminths
- a. Trematodes
  - i. Intestinal flukes
  - ii. Liver flukes
  - iii. Lung flukes
  - iv. Blood flukes
- b. Cestodes
  - i. Intestinal Infections
  - ii. Tissue infections
- c. Nematodes
  - i. Intestinal infections
  - ii. Tissue infections
  - iii. Blood infections

10/21/26

Exam 9

Mycology

10/20/26

XL. Lecture 1

Chapter 27

10/21/26

XLI. Lecture 2

10/26/26

XLII. Lecture 3

10/27/26

XLIII. Lecture 4

10/29/26		**Exam 10**	
11/3/26, 11/4/26, 11/5/26 & 11/9/26	XLVI.	Infections by Body Site a. Respiratory Infections b. Skin and soft tissue infections c. Gastrointestinal infections and food poisoning d. Central nervous system infections e. Bacteremia and sepsis f. Urinary tract infections g. Genital infections and sexually transmitted disease h. Ocular infections **Direct smear lab will follow each class**	Chapter 32 - 38, 41
11/11/26	XLVII.	Quality Control in Microbiology a. Definitions b. Quality control in the microbiology lab	Chapter 5
	XLVIII.	Infection Control a. Definitions b. Nosocomial infections c. Infection Control Practitioner and Committee d. Role of the microbiology laboratory	Chapter 3
	XLIX.	Bioterror a. Bio crime b. Laws and regulations c. Laboratory response network i. Sentinel laboratory responsibilities d. Bio threat agents	Chapter 30
11/11/26		**Exam 11**	
11/12/26	L.	Micro Case Studies	
11/16/26	LI.	Review	
11/18/26	LII.	Review	
11/20/26	LIII.	Review	
11/23/26		**Final Exam**	

Section 17

School of Medical Laboratory Science
Immunohematology Objectives
(Updated 3/9/21)

The student will at the completion of the lectures, reading assignments, and verbal instructions on immunohematology by attaining a minimum of 70% on a written or oral exam:

INTRODUCTION

1. Explain the meaning of pre-analytical, analytical and post-analytical components of blood banking
2. Give examples of troubleshooting methods in blood banking
3. Interpret results obtained in blood banking and clinically correlate the results
4. Assess the various services found in a typical blood bank
5. Discuss the inheritance patterns exhibited by various blood group systems
6. Explain why the study of population genetics is important in Blood Banking
7. Calculate allele and gene frequencies using the Hardy-Weinburg formula

BLOOD GROUP ANTIGENS AND ANTIBODIES

8. Define the terms introduced in the text and lecture
9. Discuss several factors affecting antigenicity.
10. Contrast the effects of number, density, and location of antigen sites on antigen reactivity.
11. Describe antigenic tolerance.
12. Discuss the criteria involved in determining the clinical significance of a blood group antibody.
13. Given a series of reactions, determine the reaction temperature and whether immune or naturally occurring antibodies are present

IN VITRO ANTIGEN-ANTIBODY REACTIONS

14. Name and briefly describe several lines of defense and the factors influencing antigen-antibody reactions including the cells involved.
15. Discuss how the following mechanisms aid in enhancing agglutination:
    a. Centrifugation.
    b. Albumin.
    c. Antihuman sera.
    d. IgM antibodies.
    e. Chemically modified IgG antibodies.
16. Name several enzymes used in blood bank and discuss advantages and disadvantages of each

17. Given an RBC antigen, determine if that antigen would be enhanced, destroyed or not affected by enzymes
18. Given a set of reactions, determine the next procedure to be performed (absorption, elution or inhibition
19. List 4 different types of reagents used in blood bank testing.
20. Describe the difference between complete and incomplete antibodies.
21. Briefly describe the action of each of the common enhancement media

ANTIGLOBULIN TESTING

22. State the principle of the antiglobulin test.
23. Contrast the differences between the direct and indirect antiglobulin tests including the principle, uses and procedure.
24. Assess results of the IAT; determine acceptability of those results and additional action to be taken.
25. Assess results of the DAT; determine the acceptability of those results, the antibody class and the probable source of the antibody.
26. List factors affecting the antiglobulin test procedure, which result in false positives.
27. List factors affecting the antiglobulin test procedure, which result in false negative.
28. State the components of polyspecific Anti-Human Globulin Serum (AHG), including preparation and applications
29. Discuss the uses, advantages and disadvantages of the anti-complement component in AHG reagents.

ABO BLOOD GROUP SYSTEM

30. Describe the inheritance and biochemistry of the ABO system antigens and the corresponding antibodies
31. List the major ABO phenotypes and their frequencies in various racial populations
32. Given a specific ABO antibody, describe its immunoglobulin class, mode of stimulation and clinical significance
33. Describe the inheritance and biochemistry of the H antigen, its immunoglobulin class, its mode of stimulation, clinical significance, its interaction with the Se system, and its effect on the expression of ABO antigens.
34. Describe the Bombay Phenotype and its clinical significance
35. Given a set of reactions, determine if a weak subgroup of the ABO antigens is present, its clinical significance and what further testing should be performed, if indicated.
36. Given phenotype or genotypes of parents, predict the phenotypes and genotypes of the offspring
37. Given a set of reactions, evaluate and identify technical problems that might be present, discuss the cause of inaccurate results and recommend methods to correct these problems
38. Given results of a forward and reverse typing, evaluate for technical problems and/or discrepancies, classify the discrepancies as involving serum or cells and select the method most useful in resolving the problem or discrepancy.
39. Evaluate the effects of polyagglutination on red cell testing, the categories, confirmation procedures, and an example of each
40. Correlate other information from a patient's history that may aid in resolving an ABO discrepancy.
41. Briefly describe the significance of rouleaux, prozone, and panagglutination in ABO testing.

THE Rh SYSTEM

42. Compare the Wiener, Fisher-Race, and Rosenfield theories of inheritance and convert notations from one nomenclature into another.
43. Describe the biochemical characteristics of the Rh antigen, the major antigens and their frequencies
44. Evaluate factors resulting in the expression of the weak D and the Rh null phenotype.
45. Describe the characteristics of Rh antibodies (immunoglobulin classes, their mode of stimulation, and their clinical significance in transfusion and/or HDN).
46. Explain the dosage effect in Rh antigen-antibody reactions.
47. Analyze causes of false positives and false negatives in Rh testing.
48. Describe what RBC morphologic abnormality is exhibited in individuals with the Rh null phenotype.
49. Evaluate Rh results, determine if a discrepancy exists and describe the methods to resolve any problems
50. Evaluate Rh results and determine which blood type is acceptable for transfusion including Rh_{null} individuals.
51. Given a specific Rh genotype, determine what antibodies may be produced, their mode of stimulation and discrepancies caused when typing, if any.

MISCELLANEOUS BLOOD GROUP SYSTEMS

52. Discuss the Kell, Duffy, Kidd, MNSs, P, I, Lutheran and Lewis blood group systems to include:
    a. Major alleles and their relative frequency and dominance patterns
    b. Biochemistry of antigens including those affected by enzymes
    c. Methods of antibody stimulation for each antigen.
    d. Immunoglobulin class of antibodies directed to each major antigen.
    e. Unusual patterns of inheritance seen in various races including null phenotypes
    f. Phase of testing in which the antibodies are most often detected, whether “naturally occurring” or ‘immune’ and the clinical significance, including transfusion reactions and HDN
53. Differentiate the antibodies that show dosage from those that do not
54. List diseases associated with the major blood group systems.
55. Define "high frequency" and "low frequency" antigens. List five antigens in each category.
56. Discuss the relationship between the Lewis system and secretor status including substance present in secretions based on a given genotype.
57. Explain the changes of the Lewis antigens that occur during pregnancy and in the newborn
58. Discuss the interaction of the H, ABO, Se and Le systems in the expression of Lewis antigens.
59. Discuss the Duffy phenotype associated with resistance to infection by Plasmodium knowelsi and P. vivax.
60. Discuss the major characteristics of the blood group systems introduced in the text and manual
61. List the antibodies which were formerly classified as HTLA and describe their clinical significance.
62. Explain the relationship between Bg antigens and the HLA system.
63. Define compound antibody. Give two examples.

ANTIBODY DETECTION

64. List the phases used in antibody detection and discuss the importance of each.
65. Discuss the use of antibody detection in the following situations:
    a. Transfusion of RBC's
    b. Prenatal/Neonatal Evaluations
    c. Disease Processes
    d. Transfusion Reactions
66. Explain the use of RBC reagents, AHG and enzymes in antibody detection and identification.
67. List clinically important and commonly encountered antigens possessed by reagent RBC's.

ANTIBODY IDENTIFICATION

68. Given panel results, access the antibody present, use the rule out technique, and identify the antibody. Describe how the “rule of three” is used to ensure antibodies are identified with at least 95% accuracy
69. Given patient results, determine what information from the medical history may aid in antibody identification.
70. Compare reagent RBC's from antibody screen and antibody panel cells.
71. Explain how a patient's phenotype may aid in antibody identification.
72. Recognize reaction patterns associated with the most frequent problems that occur in blood banking and outline steps to resolve these problems
73. Define elution, adsorption, and neutralization and explain their uses.
74. Given the results of an antibody identification panel, evaluate the results and determine if the antibody is exhibiting dosage.

COMPATIBILITY TESTING

75. Given a patient’s crossmatch results, determine if it is safe to transfuse and, and, if not safe, what action should be taken next.
76. Recall four objectives of pretransfusion testing.
77. Explain the importance of and how to positively identify a patient.
78. Describe the proper specimen for the crossmatch procedure and list required information for proper specimen labeling and identification.
79. Explain the importance of reviewing a patient's transfusion history.
80. List preliminary tests for a patient sample and explain the importance of each.
81. Given the results of a patient’s ABO, Rh, antibody screen and panel, select suitable whole blood, packed cells, and/or plasma for transfusion.
82. Describe two main functions the crossmatch procedure serves, its effectiveness and limitations.
83. Contrast the major vs. minor crossmatch procedures.
84. List the considerations for the following:
    a. Transfusion of Non-Group Specific Blood
    b. Transfusion of Plasma Products
    c. Massive Transfusion
    d. Intrauterine and Neonatal Transfusions
    e. Autologous Transfusion
    f. Directed Donation
    g. Emergency transfusion
85. Given a patient’s surgical procedure, hematology results and blood typing, determine the use of the "Type and Screen" versus a full crossmatch.
86. Discuss the re-identification of a patient prior to transfusion.

BLOOD DONOR SELECTION AND PHLEBOTOMY

87. List the parameters of donor physical examination used to determine acceptability.
88. Given the results of a prospective donor's medical history and physical results, determine eligibility and indicate action to be taken if not able to donate
89. Describe two methods of preparing a venipuncture site for blood donation.
90. Describe the equipment used in collecting blood.
91. Discuss phlebotomy, care of donor during and after blood collection, and processing of a unit.
92. Given a donor reaction, access the situation and determine what action should be taken.
93. Given a donor's surgical status and the results of screening tests, determine the special donor category and describe the donor criteria for that category.
94. List information in the computer that must be evaluated before donor is allowed to donate.
95. Calculate the amount of blood to be drawn and to adjustment of the volume of anticoagulant, for donors who weigh less than 110 pounds.

ANTICOAGULANTS, STORAGE, AND DONOR TESTING

96. Discuss RBC metabolism, the metabolic pathways, the mechanisms for cell survival and in vivo function
97. Describe the chemical composition of the RBC membrane and the functions of each component
98. List the globin chains found in HbA, HbA2, HbF, and glycosylated hemoglobin and their respective concentrations found in vivo
99. Describe the function of hemoglobin and its effect on the oxygen dissociation curve
100. Describe biochemical and metabolic changes related to red cell storage.
101. Support the statement; "The Hgb/O_2 dissociation curve results in a shift to the left during red cell storage."
102. Define red cell viability, shelf life, and "lesion of storage".
103. Discuss blood preservative solutions and the storage conditions for each
104. Describe the anticoagulant/preservative solutions routinely used in blood banking. Include their composition, mechanism of function, purpose, and shelf-life:
105. Discuss the current trends in anticoagulant/preservative research.
106. Evaluate how the use of an additive system increases red blood cell viability.
107. Discuss types of blood substitutes currently available
108. Describe the metabolism and function of platelets
109. Describe the testing required in the processing of donor blood.

COMPONENTS

110. Given a specific component, indicate the acceptable anticoagulants, storage conditions, and shelf life for that component.
111. List the advantages and disadvantages of RBC freezing, the preservative used and storage conditions
112. Given patient results and the number of units transfused, calculate the expected in vivo change.
113. Explain the format for ABO, Rh, and antibody screen testing.

WBC, PLATELET ANTIGENS & APHERESIS

114. Differentiate between and HLA and an HGA antibody.
115. Assess the need to test for platelet antibodies.
116. Differentiate between cytapheresis, leukapheresis, plasmapheresis and platelet pheresis.
117. Briefly describe the setup of a continuous flow and an intermittent flow pheresis instrument.
118. Discuss donor preparation for pheresis procedures.
119. Given the date and type of last pheresis, determine when a donor would be eligible to donate again.
120. Recall the minimal yield for pheresis platelets from a single donor.
121. Discuss testing and storage of platelets and granulocytes.

TRANSFUSION REACTIONS

122. Discuss the following reactions as to symptoms, causes, prevention and therapeutic measures:
    a. Acute hemolytic transfusion reactions;
    b. Febrile non-hemolytic transfusion reactions;
    c. Bacterial contamination;
    d. Anaphylactic reactions;
    e. Allergic reactions;
    f. Circulatory overload; and
    g. Non-cardiogenic pulmonary reactions.
123. Discuss the Pathophysiology of the three interrelated mechanisms involved in the acute hemolytic transfusion reaction.
124. List the four most commonly identified antibodies causing HTR.
125. Name causes of the delayed hemolytic transfusion reaction.
126. Given patient results, determine if a transfusion reaction has taken place, the type of reaction, the type of immunization response, and what action should be taken.
127. Discuss the common transfusion associated diseases, including clinical manifestations, modes of prevention, and methods of diagnosis:
128. Describe the requirements for maintaining transfusion records and the type of records that are maintained.

HEMOLYTIC DISEASE OF THE NEWBORN

129. List the four mechanisms, which must be present for HDN to occur
130. Given a patient result, determine the category of hemolytic disease of the newborn, the severity of the disease, further testing needed, expected results, treatment methods, and the probable outcome of the disease.
131. Given the mothers antibody status, assess the appropriate blood product to be used in an intrauterine transfusion, the method for selecting the blood, the type, amount and preparation of the blood, and the expected outcome
132. Given the results of the Kleihauer-Betke test, explain the principles of the test, determine the amount of the fetal-maternal hemorrhage and the number of units of Rh Immune globulin indicated
133. Explain the mechanism of red cell destruction in HDN.
134. Differentiate between the effects of red blood cell destruction in the fetus and in the neonate.

135. Discuss the basis upon which an amniocentesis is performed when diagnosing HDN.
136. Discuss the testing that occurs to monitor an infant following an exchange transfusion.
137. Discuss the principle of preventing Anti-D HDN using Rh immune globulin.
138. Define kernicerus.
139. Explain why the fetal liver is incapable of conjugating bilirubin.
140. Explain how ABO incompatibility between mother and fetus may actually protect against the development of Rh HDN.

AUTOIMMUNE HEMOLYTIC ANEMIAS

141. Given patient results, characterize the type of hemolytic anemia present, including its thermal amplitude, type of protein coating the red cells, and method of red cell destruction.
142. Given patients results, determine if benign or pathologic cold auto agglutinins are present, including laboratory procedure, the expected lab results, problems encountered in testing, and treatment.
143. Differentiate between drug-induced immune hemolytic anemia and idiopathic warm autoimmune hemolytic anemia.
144. Identify the medications responsible for the four classic mechanisms of drug-induced hemolysis, the routine laboratory findings and mode of red cell destruction.
145. Given a patient's symptoms, determine the type of anemia present; explain the laboratory procedures to be performed, and clinical findings expected.
146. Discuss the mode of red cell hemolysis in WAIHA (warm autoimmune hemolytic anemia) and the challenges in serological testing and selection of blood for transfusion due to the presence of warm autoantibody.

GENETICS AND PATERNITY TESTING

147. Discuss the processes of cell division
148. Describe and differentiate the principles of inheritance
149. Prepare and discuss pedigree charts including the expression of dominant and recessive traits.
150. Contrast and discuss the terms genotype and phenotype.
151. Describe several factors that influence the suitability of genetic markers to be used in paternity testing.
152. List 6 RBC and WBC antigen systems commonly used in paternity testing and the reliability of each system.
153. Describe necessary records that must be maintained with any paternity testing case.
154. Describe testing methods for RBC antigens, HLA antigens, RBC enzymes, serum proteins and DNA testing, including indications for the test, technical problems, false results and confirmatory testing.
155. Given the results of paternity testing, determine if a direct (first order) or an indirect (second order) exclusion is applicable and determine the paternity index, probability of paternity and the probability of exclusion.
156. Assess the advantages and disadvantages of DNA, Polymorphism, RFLP, and PCR methods in DNA testing.

QUALITY ASSURANCE

157. Name three Federal Accrediting Agencies and three peer review groups discussed in lecture, their purpose, and the primary objectives of these agencies or groups.
158. Describe the "general considerations" behind the procedure manual, checking results and records, proficiency testing, review committee and adverse effects, reporting abnormal findings and continuing education.
159. Given a specific piece of equipment, determine the type of preventative maintenance required, the QC necessary, and the intervals of testing.
160. Given information regarding a specific activity, determine if it qualifies as QA or QC.
161. Given the results of quality control results, determine the acceptability of the results, access the problem, if any, and the corrective action to be taken.
162. Given a specific blood bank reagent, discuss the proper quality control method for that reagent, the frequency of quality control checks, the expected results, and action to be taken if quality checks are not acceptable.
163. Describe QC involved in the following: blood component preparation and storage, performing any necessary calculations involved.

MT 402 Immunohematology



Instructor: Cyndee S. Lowe, M.A., MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, laboratory exercises, question and answer

Required Courses: Sixteen semester hours of biology and chemistry, a college level math class, and a minimum of three years of college with the guarantee of a B.S. degree at completion of the clinical year

Course Goal: To introduce the student to immunohematology and to prepare the student to function as an entry level technologist/scientist in the immunohematology department.

Textbook:

Harmening, Denise M. *Modern Blood Banking & Transfusion Practices*. Philadelphia, PA: F.A. Davis Company, 2019, Seventh Edition

Other References:

Henry's Clinical Diagnosis and Management by Laboratory Methods, McPherson, Richard A and Matthew R. Pincus, 23rd edition, 2017

Technical Manual, American Association of Blood Banks, AABB, 18th edition, 2014

Instructions: Bring texts to class every day.

DATE:	TOPIC:	READING ASSIGNMENT:
8/13/26	I. Introduction a. History of Blood Banking b. General overview of Transfusion Medicine i. Pre-analytical ii. Analytical iii. Post-analytical c. Genetics for Blood Banking i. Inheritance patterns ii. Population genetics d. Immunology for Blood Banking i. Immune response ii. Immunoglobulins iii. Complement	Chapters 1, 2, and 3
8/18/26	II. Blood Group Antigens a. Introduction b. Antigenicity c. Antigen specificity d. Variables affecting antigenicity e. Antigenic tolerance III. Blood Group Antibodies a. Alloantibodies b. Autoantibodies IV. In-vitro Antigen-Antibody Reactions a. Influencing factors b. Mechanisms of enhancing agglutination c. Detecting reactions d. Serological testing methods e. Enhancement media f. Reagents g. Cells h. Molecular diagnostic techniques	Chapters 3 and 4
8/20/26	V. Blood Bank Testing Methods a. Immediate Spin i. principle ii. uses b. 37^{o} incubation	Chapter 5

DATE:		TOPIC:	READING ASSIGNMENT:
		c. Antiglobulin i. principle ii. Antihuman Globulin reagents iii. Direct antiglobulin test iv. Indirect antiglobulin test v. validation vi. factors affecting AHG results vii. sources of error	
8/25/26		**Grading Reactions Lab**	
8/27/26 & 9/1/26	VI.	ABO Blood Group System a. ABH antigens and genetic inheritance b. ABO antibodies c. ABO testing d. Soluble ABO antigens e. Unusual ABO phenotypes f. ABO discrepancies i. weak or missing reactions ii. miscellaneous discrepancies iii. resolution iv. case studies	Chapter 6
9/8/26		**Exam 1**	
9/10/26	VII.	Rh System a. Antigens b. Nomenclature c. Antibodies d. Variants e. LW system	Chapter 7
9/15/26		**ABO/Rh Blood Typing Lab**	
9/17/26 9/22/26	VIII.	Other Blood Group Systems a. Lewis system b. MNS system c. P system d. Ii system e. Kell system f. Duffy system g. Lutheran system h. Other smaller blood group systems	Chapters 8 & 9

DATE:		TOPIC:	READING ASSIGNMENT:
9/24/26		**Exam 2**	
9/29/26	IX.	Antibody Detection and Identification a. Antibody Screen	Chapter 10
10/1/26 10/6/26 & 10/8/26		**Antibody Screening Lab** b. Antibody Panels c. Methods i. Rule out procedure ii. Problem solving iii. Case studies	
	X.	Compatibility Testing a. Methods b. Samples	Chapters 11 & 12
10/13/26		c. Selecting donor units d. Crossmatch e. Special circumstances f. Phenotyping	
10/15/26	XI.	Blood Donor Selection and Phlebotomy a. Selection i. Physical exam ii. Medical history iii. Information given for donor consent b. Donor phlebotomy c. Apheresis d. Autologous donation e. Donor reactions f. Testing and labeling	Chapter 13
10/20/26		**Exam 3**	
10/22/26 & 10/23/26	XII.	Components and Therapy a. Whole blood b. Red blood cells c. Platelets d. Plasma e. Cryoprecipitate, PCC, Factor VIII & Factor IX f. White blood cells g. Component transfusions and Apheresis Therapies h. Case studies	Chapters 14 and 15 (also parts of chapters 1, 16 and 18)

DATE:	TOPIC:	READING ASSIGNMENT:
10/26/26 & 10/28/26	XIII. Transfusion Reactions a. Hemolytic reactions b. Immediate non-hemolytic reactions c. Delayed non-hemolytic reactions d. Investigation	Chapters 14 and 17
11/3/26	XIV. Hemolytic Disease of the Fetus & Newborn a. Pathophysiology b. Factors affecting immunization & severity c. Clinical manifestations d. Treatment e. Laboratory testing and Rhogam f. ABO HDN	Chapter 20
11/5/26	XV. Autoimmune Hemolytic Anemias a. Cold b. Warm c. Drug induced	Chapter 21
11/6/26	**Exam 4**	
11/10/26	XVI. HLA System, Transplant and Relationship Testing a. Clinical significance b. Exclusions	Chapters 19, 23 and 24
11/12/26	XVII. Quality Assurance and Legal & Ethical Issues a. Accrediting agencies b. AABB quality system essentials c. QC in the Blood Bank d. Legal and ethical issues	Chapters 25-29
11/13/26	Review	
11/17/26	Review	
11/19/26	**Final Exam**	

Section 18

SRMH Healthcare
MLS School

MT 404-Urinalysis and Body Fluids

Lecture Objectives

The student will at the completion of each of the units on urinalysis, reading assignments, practical application with a 70% accuracy on a written or practical exam unless otherwise stated. The student will:

Unit Topic I

1. Describe and recognize the anatomy and functions of the kidney to include the nephron, glomerulus, tubular portions and excretion system. Analyze an unknown fluid to determine if it is urine by examining the urea and creatinine.

2. Identify the normal composition of urine. Describe the different types of urine specimens and their use to include the following:
    - Random specimen
    - First morning specimen
    - Fasting specimen
    - 2-Hour postprandial specimen
    - Glucose tolerance urine specimens
    - Catheterized specimens
    - Midstream Clean-Catch specimen
    - Suprapubic aspiration
    - Prostatitis specimen
    - Pediatric specimen
    - Drug specimen collection
    - 24 Hour Urine Specimen

3. Identify and utilize each urine preservative with the appropriate test.

4. Perform, interpret and clinically correlate the tests included in a routine urinalysis. List the exogenous and endogenous causes of hemoglobinuria.

5. Interpret the various colors of urine giving the possible clinical significance and test utilized as a follow-up to the respective color.

6. Identify and interpret the clarity of urine to include the following:

    - Clear
    - Hazy
    - Cloudy
    - Turbid
    - Milky

    Explain causes of turbidity in acid and/or alkaline urine. Identify substances that may dissolve turbidity in a urine specimen.

7. Perform the test of specific gravity with the urinometer, refractometer, dipstick, and automated methods. Explain the methodology, normal and abnormal values, and interpret possible disease states associated with a high, low or fixed specific gravity.

8. Define and clinically correlate to pathological conditions the following terms: polyuria, oliguria, anuria, antidiuretic hormone deficiency, renal threshold of glucose, and isosthenuria. Explain the normal urine volume of a 24 hr specimen and a random specimen.

9. Discuss the advantages, disadvantages and perform corrections (temperature, presence of protein and glucose) for each type of measurements for specifc gravity, if necessary.

10. Evaluate quality control data and identify discrepancies when controls do not meet specifications. Devise a plan to correct these problems.

Unit Topic II

11. Use the binocular microscope correctly and explain the ocular lens and objectives working together to produce the total magnification. Calculate the various magnifications by using the ocular lens and different objectives.

12. Adjust the microscope to better visualize a urine microscopic sediment. Explain the different urine microscopic techniques that may be used to include bright field, phase contrast, polarizing, dark field, fluorescence, and interference contrast. Discuss the microscopic stains to include Sternheimer-Malbin, toluidine blue, 2% acetic acid, lipid stains, Gram stain, Hansel stain, and Prussian Blue stain.

13. Identify visually or from a written description the following casts, and clinically correlate these casts with possible pathological conditions. Discuss the composition of each cast and relate this to the appearance with a polarized light, i.e. a maltese cross appearance. Explain how these casts are formed from use of an electron microscope.

    Hyaline casts
    Epithelial cell casts

Red cell casts
White cell casts
Granular casts, both coarse and fine
Waxy casts
Fatty casts
Pigmented casts
Broad casts
Bilirubin in casts

14. Describe formation sites for the above list of casts.

Unit Topic III

15. Identify from appearance or written description the following microscopic structures which may be seen in a urine sample. Explain the use of stains to aid in the identification of some of these structures (Sudan III, Sternheimer Malbin, etc.)
    Crystals in alkaline urine:
    Amorphous carbonates
    Triple phosphate
    Calcium carbonate
    etc.

    Crystals in acid urine:
    Amorphous urates
    Uric acid
    Calcium oxalate

    Microscopic structures:
    erythrocytes, leukocytes, glitter cells, epithelial cells, oval fat bodies

    Crystals found in abnormal urine:
    Cystine, tyrosine, leucine, sulfonamide
    Miscellaneous findings:
    Mucus threads, yeast cells, bacteria, etc.

16. Identify normal and abnormal test findings for all structures in #15 and clinically correlate the test findings with possible pathology. Identify the need for future testing and suggest useful additional tests.

17. Verify test results for the above testing. Identify urine microscopic structures that may be confused with red blood cells such as yeast, oil droplets, Ca oxalate and air bubbles.

18. Make judgments concerning the need for future testing which may be necessary to confirm a diagnosis or rule out a specific disease.

19. Analyze case studies and correlate results to health or disease. Name the most likely disease. (For example: clinically correlate the need for a urine eosinophil count.)

Unit Topic IV

20. Describe and perform testing with the reagent strips used for chemical analysis of urine to include pH, protein, etc.

21. Explain the storage and appropriate quality control checks for these reagent strips.

22. Discuss automation in urinalysis such as Ursys 1100 system used at RMH and the Sysmex UF-1000 urine cell analyzer.

23. Discuss urine odor in health and in various diseases.

24. List and interpret urine pH measurements for the normal and abnormal patient.Correlate the urine pH with stone formation. Perform urine pH measurements and note the appropriate specimen to be used.

25. Discuss and perform urine osmolality and clinically correlate the results to the appropriate disease.

26. Verify all testing results listed in objective #20-25.

27. Analyze and interpret quality assurance programs for urine pH, odor, osmolality, creatinine clearance and GFR.

28. Identify when controls do not meet quality assurance specifications, analyze the situation, and devise a plan to correct the quality control problem.

Unit Topics V and VI

29. Discuss the test principle, reagents, appropriate specimen, methodology, sources of error, normal values for the following urinary protein tests. Clinically correlate test results with the appropriate disease or condition to include orthostatic proteinuria and functional proteinuria. Recognize false positives and negatives.

    - Bence Jones Protein
    - Protein Error of Indicators
    - Albumin
    - Microalbuminuria
    - Immunodip Reagent Strip for Microalbuminuria
    - Albumin-Creatinine Ratio Strips for Microalbumin
    - Sulfosalicylic Acid/turbidity for protein

30. Interpret and apply quality assurance measures utilized in the testing in #29.

Unit Topic VII

31. Describe the metabolism, methodologies, clinical significance and normal values for glucose in the urine as evidenced by the student correctly responding to 9 out of 10 case studies or unknowns given on a written or practical exam.

32. Clinically correlate testing results with diabetes mellitus or correct condition/disease.

33. Compare and contrast various methodologies for measuring reducing substances in the urine to include sources of error, false positives, false negatives and interfering substances. Analyze data and select the best method.

34. Verify testing results.

35. Summarize the comparison between glucose oxidase and clinitest results and interpret the results. Clinically correlate and apply the results. Identify when and why results do not correlate.

Unit Topic VIII

36. Explain the principles of tests, perform the tests, describe the metabolism, clinical significance, methodology and normal values for the following when found in the urine: urea, ammonia, uric acid, creatinine, creatine, amino acids, hemglobin and myoglobin.

37. Solve case studies and identify the correct diagnosis when given testing results from #36.

38. Discuss the specimen requirements for all testing of substances listing in #36.

39. Verify testing results and make judgments concerning the need for future testing.

40. Interpret and apply quality assurance data.

Unit Topic IX

41. Describe the metabolism, methodology, clinical significance and normal values for urine containing the following:

    Bile, bilirubin, urobilinogen, urobilin, porphobilinogen, uroporphyrin, coproporphyrin ketone bodies.

42. Compare and contrast methodologies to include false positives, false negatives, and sources of error for the following list of methods:

    Diazo, foam test, Ehrlich's Test, Watson-Schwartz Test, and any other tests discussed in class.

43. Clinically correlate test results with the pathological condition.

44. Evaluate and apply quality assurance data such as the checking of reagent strips for reactivity and ensuring the proper care and storing of reagent strips etc. Make required changes as suggested by the QC data.

45. Describe the various renal function tests and clinically correlate these test results with the appropriate disease.

46. Discuss and run the urinalysis instruments—Atlas and Yellow Iris.

47. Explain the various renal diseases giving the etiology and prognosis. Correlate testing results with these diseases.

48. Describe the special urinalysis screening tests such as phenylketonuria etc

49. Investigate new urinalysis procedures and research which method may be the best for your laboratory. Select the best method.

Body Fluids

The student will at the completion of the lectures, reading assignments and practical experience on body fluids: (The objective will be met when the student obtains a score of 70% or higher on a written or practical exam.) Objectives for cell counts will be found in hematology. Objectives for amniotic fluid will be found in chemistry under the lipids lecture. (additional objectives will be found here)

CSF

50. Describe the formation and physiology of cerebrospinal (CSF).

51. Explain the procedure used to collect CSF, the appearance (normal vs xanthochromia), and evidence of traumatic collection. Discuss the quality control measures utilized in the collection of CSF and other body fluids. Describe proper handling of CSF specimens for microbiology, chemistry, and serology.

52. Interpret the CSF appearance and apply it to the appropriate clinical significance.

53. Discuss the CSF protein, glucose, lactate, glutamine, lactic dehydrogenase and creatine kinase CK BB isoenzyme methodology and correlate results with the appropriate pathological condition. Identify test values that correlate with a CSF versus a serum specimen for glucose, protein, LD, CK.

54. Clinically correlate CSF and serum values for all the following: total protein, prealbumin, albumin, ceruloplasmin, transferrin, IgG, and IgA. Describe the respective concentrations for all substances listed in the CSF and serum.

55. Summarize the major CSF laboratory results utilized in making the differential diagnosis of meningitis.

56. Describe the use of the gram stain, immunologic procedures and serologic procedures on CSF. Clinically correlate results with disease or health.

57. Analzye quality control results for CSF testing, identify QC results that are outside acceptable limits, devise a method to correct the problem causing results to be unacceptable, and correct the problem.

58. Make judgments concerning the need for future testing when evaluating test results; for example, when results do not correlate, QC results to not meet established criteria, or additional testing is needed to establish a diagnosis.

Miscellaneous Body Fluids

Seminal Fluid

59. Describe the collection, medical reasons for collection, normal and abnormal composition of seminal fluid.

60. Describe the normal values for volume, viscosity, pH, sperm count, motility, quality and morphology for semen analysis. Clinically correlate these results to pathology or health.

61. Verify testing results and make judgments concerning the need for additional testing or the need to change an existing procedure.

62. Analyze testing results, identify any problems and correct these problems (such as false positives, incorrectly collected specimen, false negatives).

Synovial Fluid

63. Describe the location and composition of synovial fluid ("joint fluid").

64. Describe arthrocentesis.

65. Explain the classification and pathological significance of joint disorders.

66. Clinically correlate the laboratory findings to the appropriate group classification.

67. Describe, interpret and apply the identification of synovial fluid crystals to the appropriate pathological condition such as crystal-induced arthritis.

68. Describe, interpret and apply clinically the compensated polarized light identification of calcium pyrophospahte and monosodium urate.

69. Explain and clinically correlate testing in the chemistry, microbiology and serology laboratory on synovial fluid to health or disease.

70. Evaluate quality control data and make judgments for repeat testing or the need for additional new testing to confirm a diagnosis or rule out a disease.

71. Explain and apply clinically the laboratory differentiation of transudates and exudates.

Pleural, Pericardial and Peritoneal Fluid

72. Describe the normal and abnormal formation, appearance, hematology, chemistry, and serology tests for pleural, pericardial fluid, and peritoneal fluid.

73. Clinically correlate the test results for #72 to health or disease.

74. Verify test results for #72.

75. Evaluate QC data and make judgments regarding the need for future testing or repeat testing.

Fecal Analysis

76. Describe the specimen collection and physiology of feces.

77. Perform and clinically correlate the following tests on feces:

    Color and consistency, white blood cells, qualitative fecal fats, muscle fibers, occult blood, quantitative fecal fats, APT Test, Trypsin, methylene blue stain, and carbohydrates.

78. Analyze testing results, identify any discrepancies with results.

79. Verify test results.

80. Make judgments concerning the need for new testing or repeat testing by evaluating QC data.

Transudates and Exudates

81. Define transudate and exudates, and explain how each is formed.

82. Identify and interpret test results to include the following when evaluating a fluid as a transudate or exudate:
    - Appearance
    - WBC count
    - Serum protein ratio
    - Serum LD ratio
    - Spontaneous clotting
    - Cholesterol
    - Bilirubin ratio

Amniotic Fluid

83. Describe the process of obtaining amniotic fluid through amniocentesis.

84. Define the function of amniotic fluid.

85. Perform and interpret the L/S Ratio to include clinical correlation, adequacy of specimen, maturity of fetus in a diabetic mother versus a non-diabetic mother. Write the phospholipids designated by the L and S in L/S Ratio.

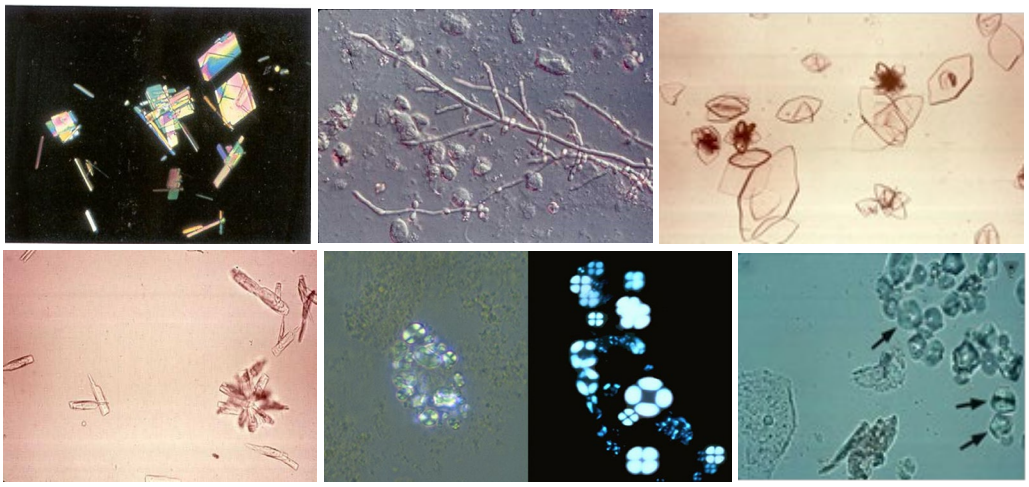
86. Identify false elevations in the L/S Ratio from substances such as blood or meconium.

87. Describe and clinically correlate the following amniotic fluid tests:
    - Foam stability
    - Fluorescent polarization albumin
    - Bilirubin scan
    - Alpha fetoprotein
    - Amniostat-fetal lung maturity

Sweat

88. Describe and clinically correlate pilocarpine ionophoresis induction of sweat in the sweat test. Clinically correlate values for chloride and sodium in the sweat and cystic fibrosis.

MT 404 Urinalysis and Body Fluids



Instructor: Abigail L. Blosser, B.S., MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, question and answer

Course Goal: To educate the student in urinalysis and body fluids so that they may function as an entry-level scientist in the clinical laboratory urinalysis and body fluid departments.

Textbook: Strasinger, Susan, *Urinalysis and Body Fluids*, F. A. Davis, Edition 7, 2021

Pre-Requisite Courses: 16 Semester hours of Chemistry plus one course in Biochemistry or Organic Chemistry

9/16/26 I. Anatomy and Physiology of the Kidney — Chapters 2-4

a. Kidney structure gross
b. Kidney, microscopically
c. Glomerulus
d. Nephron function
e. Tubular function
f. Sample – Specimen Collection – Pre-analytical component of urinalysis
    i. Preservation
    ii. 24 hour specimen
    iii. Factors affecting collection
    iv. Different types of specimens
        1. Clean catch
        2. Random
        3. Others
g. Routine urinalysis – Analytical components of urinalysis
    i. Appearance
    ii. Color: hemoglobinuria, porphyrins
    iii. Chemical testing
    iv. Microscopic
h. Urine volume: normal vs. abnormal
i. Specific gravity
j. Reporting urine results
k. Assessment of lab services in urinalysis

9/18/26 II. Microscopic Urinary Structures and the Microscope — Chapters 6, & 8

a. Microscopic urine exam
    i. Use of microscope
    ii. Ocular lens + objectives and magnification
    iii. Urinalysis microscopic techniques
        1. bright field
        2. phase contrast
        3. polarizing
        4. dark field
        5. fluorescence
        6. interference contrast
    iv. Macroscopic screening
    v. Commercial urinalysis systems
        1. KOVA
        2. Urisystem
        3. Quick-Prep System
        4. CenSlide 2000 Urinalysis
        5. R/S Workstation
    vi. Microscopic specimen preparation
    vii. Microscopic specimen volume

viii. Microscopic centrifugation
ix. Specimen microscopic exam and reporting and clinical correlations
x. Sediment Stains
1. Sternheimer-Malbin
2. Toluidine blue
3. 2% acetic acid
4. Lipid stains: Oil Red O and Sudan III
5. Gram Stain
6. Hansel Stain for Eosinophils
7. Prussian Blue Stain

b. Casts
i. Origin and formation (electron microscope)
ii. Chemical
iii. Appearance
iv. Different types of casts: hyaline, epithelial cell, white blood cell and red blood cell casts, granular casts, waxy casts, fatty casts, pigmented casts, and broad casts
v. Clinical correlation for all casts

9/21/26 III. <u>Microscopic Urinary Structures</u> Chapter 6

a. Erythrocytes: source, appearance, clinical significance
b. Leukocytes: source, differentiation, clinical significance
c. Glitter cells: description, significance, staining
d. Epithelial cells: origin, type
e. Oval fat bodies: appearance, formation, clinical significance
f. Crystals in acid urine: amorphous, urates, uric acid
g. Crystals in alkaline urine: amorphous phosphates, triple phosphate, ammonium biurates, uric acid
h. Crystals found in abnormal urine: cystine, tyrosine, leucine, sulfonamide
i. Miscellaneous findings (microscopic)
i. Mucous threads, yeast cells, spermatozoa, air bubbles, bacteria, parasites, and starch granules

9/23/26 IV. <u>Urine Microscopics</u>

a. Examination of various microscopic examples

b. Clinical correlation for all findings and hand in microscopic drawings

9/25/26 EXAM 1

9/28/26 V. Characteristics of Urine — Chapter 4, Chapter 5

a. Odor
b. Turbidity
c. pH
    i. Normals, physiology methods, indicators
d. Osmolality
    i. Principles and method

Chemical Examination of Urine Protein

e. Normals (Qualitative and Quantitative)
f. Albumin
g. Globulin
h. Tamm-Horsfall Protein
i. Other proteins
j. Abnormal proteinuria
k. Measurement
    i. Specimen – Pre-Analytic Component
    ii. Qualitative
        1. Protein error of pH indicator
        2. Protein precipitation
    iii. Semi quantitative and quantitative methods
    iv. Reporting results
    v. Interpretation of results and clinical correlation

Urinary Protein Methods

l. Reagent strip methods
m. Precipitation
n. Bence Jones Proteinuria
    i. Clinical significance
    ii. Electrophoresis

9/30/26 VI. Reducing Substances — Chapter 5

a. Clinical significance and characteristics
b. Non-diabetic glucosuria
c. Methods: glucose oxidase, copper reduction, Clinitest
d. Reaction interference for C

10/2/26 **Exam 2**

10/5/26 VII. Other/ Chemical Exam of Urine and Case Studies

a. Urea: Clinical significance and measurement
b. Creatinine
c. Creatinine clearance & Calculations
d. Ketones: Acetone, Aceto-acetic acid, Beta hydroxybutyric acid
e. Hematuria
f. Hemoglobinuria
g. Myoglobinuria

10/7/26	VIII.	Other Urine Characteristics	Chapter 9

a. Physiology
b. Bilirubin
c. Urobilin
d. Urobilinogen
e. Nitrite
f. Leukocytes
g. Specific Gravity
h. Melanin
i. Calcium
j. Chloride
k. Phenylketonuria PKU
l. Salicylates
m. Hemosiderin
n. Urinary Calculi
o. Clinical Evaluation of Renal Function
p. Quality Control in Urinalysis
q. Aminoaciduria
r. Homogentisic Aciduria
s. Maple Syrup Urine Disease

10/9/26 **Exam 3**

10/12/26 10/14/26 10/16/26	IX.	Body Fluids	Chapters 11-15

a. Seminal fluid
    i. Specimen
    ii. Normal Values
    iii. Sperm morphology
    iv. Sperm viability
    v. Seminal fluid fructose
    vi. Anti-sperm antibodies
b. Synovial fluid
    i. Specimen and normal values
    ii. Tests and joint disorders
    iii. Crystal identification
c. Serous fluids
    i. Transudates and exudates
d. Pericardial fluid

e. Pleural fluid
f. Peritoneal fluid
g. Amniotic fluid
    i. Function and specimen
    ii. Testing
        1. Foam stability test
        2. Fluorescent polarization albumin
        3. Bilirubin scan
        4. Alpha fetoprotein
        5. L/S Ratio
        6. Amniostat-fetal lung maturity
h. Sweat
    i. Cystic fibrosis
    ii. Sweat test and cystic fibrosis (clinical correlation)
i. Feces
    i. Specimen and normal values
    ii. Color and appearance
    iii. Occult blood
    iv. Methylene blue
    v. APT test
j. Cerebrospinal Fluid (CSF)
    i. Specimen and function
    ii. Appearance and xanthochromia
    iii. Traumatic tap versus hemorrhage
    iv. Clinical significance
    v. Cells in CSF

10/19/26

Final Exam – Urinalysis and Body Fluids

Section 19

Sentara RMH School of Medical Laboratory Science

MT 401 Clinical Immunology Lecture Objectives

(Reviewed 3/9/21)

OBJECTIVES:

The student will at the completion of the lectures on immunology, reading assignments and class discussions by attaining a minimum of 70% accuracy on a written test and/or oral exam.

1. Define immunology, antigen, hapten, antibody, immunoglobulin, and immune complex.
2. Identify, list types, and compare innate (natural) and adaptive (acquired) immunity.
3. Classify an example of immunity as being innate, adaptive, cellular or humoral.
4. Explain the difference between active, passive, or adoptive immunity and apply this knowledge to a specific immune response.
5. Describe the cells involved in the immune system and give the function of each.
6. Explain the functions of the lymphatic system and the spleen.
7. Describe the four major groups of cytokines and give the predominate cell source and its primary function.
8. Describe specificity and immunological memory.
9. Explain antigen recognition involving B-cells and T-cells. Identify the immunoglobulin classes most commonly found on the surface of circulating B lymphocytes in the peripheral blood of normal persons.
10. Describe, identify, and apply primary and secondary antibody response to an antigen.
11. Explain the difference between T-dependent and T-independent antigens.
12. Explain the process of the activation of T-helper, T-cytotoxic lymphocytes, and B-cells.
13. Explain how T-cytotoxic lymphocytes, natural killer cells, antibodies, and macrophages eliminate an antigen.
14. Explain, interpret and apply the mechanisms of the nonspecific immune response.

15. Explain, interpret and apply the major histocompatibility complex.

16. Explain the pathological process involved in the four types of hypersensitivity to include types I, II, III, and IV.

17. Describe and identify examples of hypersensitivity types I, II, III and IV.

18. Explain the process of immune complex deposition in tissues.

19. Describe tumor immunology to include natural immunity to tumors and T cell mediated immunity to tumors, including cytokines and cytotoxic T-cell immune mechanisms.

20. Draw and describe the parts and give the functions of the different immunoglobulins to include the Fc component, Fab component, J chain, secretory component, heavy chain, light chain, constant region, variable region, hinge region and define isotype, allotype, and idiotype.

21. Describe how the immunoglobulins differ with regard to function and structure. Describe the subclasses of IgG.

22. Explain how the immunoglobulin classes are detected.

23. Describe the production of monoclonal antibodies and explain how they are used in the laboratory.

24. Describe the importance and methodology for quantitating immunoblobulins in body fluids other than serum. Interpret test results and clinically correlate with the appropriate disease when light chains are seen in the urine of patients with multiple myeloma.

25. Explain the difference between immunogen and antigen, and describe the five factors that contribute to immunogenicity.

26. Define the terms hapten, adjuvant, antigenic determinant, and epitope.

27. Explain how antigens and antibodies interact, and describe their detection in the laboratory. Identify where antigen-antibody complexes are likely to be deposited in the body and why.

28. Draw, label the parts, and interpret the precipitation curve to include zone of equivalence, prozoning, and postzoning.

29. Recognize and interpret the various types of precipitation reactions to include the Ouchterlony technique and identity, partial identity and non-identity as well as other types of precipitation.

30. Describe the various applications of precipitation reactions.

31. Compare the differences between precipitation and agglutination.

32. Explain the phases of agglutination when a lattice is formed.

33. Describe the various types of agglutination reactions and the methods of enhancing the reactions.

34. Draw the three complement cascade systems. Indicate the functions of each segment in the complement cascade system. List the activators for each of the systems.

35. Describe testing for type I hypersensitivity (total IgE or allergen-specific IgE) reactions to include skin prick tests, intradermal testing, (older) RAST test, chemiluminescent enzyme immunoassay, and Immuno CAP.

36. Explain, interpret, and apply the various labeled immunoassays.

37. Describe and apply the various methods utilizing immunofluorescence and nephelometry in the evaluation of the immune system and disease.

38. Explain, interpret, and apply clinically flow cytometry, lymphocyte transformation, mixed lymphocyte culture, cytotoxicity, measurement of immune activation, and neutrophil function assays.

39. Describe the biochemical principles utilized in the use of nucleic acid probes. Give specific examples of the clinical utility of molecular techniques in the laboratory.

40. Explain, interpret, and apply clinically Southern blot, Northern blot, and Western blot. Discuss the importance of molecular techniques in the clinical laboratory.

41. Describe the principles of the polymerase chain reaction.

42. Clinically correlate lab test results from molecular techniques/diagnostics to disease or health.

43. Describe a Streptococcal infection with regard to clinical symptoms and poststreptococcal sequelae.

44. Interpret, run, and clinically correlate test results for the following methods: ASO and anti-streptolysin “O” enzyme inhibition test, ADN-B, Rapid-Cycle Real Time Polymerase Chain Reaction, group A strep direct probe test (DNA chemiluminescence probe assay) and rapid screening tests.

45. Analyze procedural discrepancies that may occur during testing in immunology, and devise a course of action and solve those discrepancies. Examples might include controls which do not meet pre-established criteria, false positive results, false negative results etc.

46. Make judgments concerning the need for future testing with any of the methods listed in #44.

47. Explain reasons for false positives and false negatives for testing in #44.

48. Describe syphilis with regard to the causative organism, clinical symptoms, and useful laboratory tests. Clinically correlate testing results with the disease. Solve case studies giving testing

results and symptoms by giving the disease such as syphilis or some other disease. Solve problems as they arise during this process.

49. Explain the stages of syphilis and which tests are positive in the various stages.

50. Describe direct detection tests for syphilis and in what stage they are positive.

51. Explain the serology tests which are useful in the diagnosis of syphilis, indicate the difference between the treponemal and nontreponemal tests and at which stage these tests are useful.

52. Describe Borrelia burgdorferi, the causative agent of Lyme disease, and list the organism's major antigenic components. Explain the transmission of the disease, and the various symptoms of each stage of the disease. Describe the appearance of IgG and IgM in the disease. Solve case studies utilizing this knowledge.

53. Describe the organism, symptoms, and complications of acute rubella virus infection, and explain the major abnormalities associated with congenital rubella infection. Describe the appearance of IgG and IgM during the course of these rubella infections.

54. Describe, interpret, and apply the following tests utilized in rubella antibody testing: Hemagglutination inhibition, passive hemagglutination, solid-phase immunoassays, and sucrose density gradient ultracentrifugation. Solve case studies utilizing testing results from the methods and identify the disease.

55. Explain the diseases caused by Epstein-Barr virus, and describe, interpret, and apply tests used to detect heterophile antibodies. Solve case studies using testing results to identify the disease.

56. Explain the characteristics, epidemiology, and clinical manifestations of all the hepatitis viruses. Identify in a hepatitis B virus picture the surface antigen, core antigen and viral DNA.

57. Describe the various methods of testing for all hepatitis viruses discussed in class, and solve case studies with lab results by correctly correlating the disease with the results. For example, interpret test results for HBsAg, anti-HBc IgM , anti-HAV IgM, and other test combinations and select the correct virus and recent vs acute vs chronic disease. Explain the graph in the textbook showing all test results and correlation with the stage of hepatitis virus disease.

58. Describe the structure, life cycle, epidemiology, clinical manifestations, and current therapy for AIDS (HIV virus.)

59. Explain, interpret, and apply clinically the methods utilized in the laboratory diagnosis of HIV infections. Solve case studies by correlated the lab results with the disease or health. Interpret Western Blot test results for HIV and explain the criteria that the CDC recommends for a positive test.

60. Describe the following: Rickettsia diseases, mycoplasma, legionella, toxoplasma, cytomegalovirus, and human T-cell leukemia virus. Correlate testing results with the appropriate diagnosis. Analyze any discrepancies in quality control results as they arise in the testing, and

determine an appropriate course of action to resolve the problem. Solve case studies by correlating test results with disease or health.

61. Explain, interpret, and clinically correlate cold agglutinin test results utilized in the diagnosis for mycoplasma. Analyze cold agglutinin test results when results vary and determine the appropriate course of action.

62. Describe tolerance, anergy, apoptosis, and the relationship between immune activation and tolerance.

63. Explain autoimmunity, its general mechanism, and the theories that cause autoantibody production.

64. Correlate clinically the patterns seen in the antinuclear antibody test to the appropriate disease or health.

65. Describe, interpret, and apply testing results for the following diseases: Lupus erythematosis, rheumatoid arthritis, Sjogren's syndrome, scleroderma, polymyositis-dermatomyositis, autoimmune hemolytic anemia and ankylosing spondylitis.

66. Analyze test results listed in #65 for false positives and false negatives.

67. Describe how non-organ specific and organ-specific autoimmune diseases differ.

68. Describe and identify the autoimmune antibodies and changes in the immune system associated with the following: myasthenia gravis, diabetes mellitus, idiopathic adrenal failure, autoimmune bullous skin diseases, Good-pasture's syndrome, and spermatozoa antibody-mediated infertility. Solve case studies utilizing this information.

69. Explain the differences between primary and secondary immune deficiencies.

70. Recognize, interpret, and clinically apply the lab findings of hypergammaglobulinemias monoclonal or polyclonal based on serum protein electrophoresis scans. Draw the densitometer tracing of a normal serum protein electrophoresis on cellulose acetate media with a buffer pH of 8.6 and label the following:
    - Anode
    - Cathode
    - Direction of migration
    - Glamma globulin
    - Albumin
    - Alpha 1
    - Alpha 2
    - Beta
    - Positive electrode
    - Negative electrode
    - Identify where IgG, IgA, IgM, IgD migrate

71. Describe the differences between lymphoma and leukemia, and interpret lymphocyte markers used in the classification of leukemias and lymphomas.

72. Explain autologous, syngeneic, allogeneic, and xenogeneic as they relate to a graft.

73. Describe and interpret tests used to phenotype the ABO blood group and HLA-A, HLA-B, HLA-D, and HLA-DR.

74. Describe the immunosuppressive effect of certain drugs such as cyclosporin A etc.

75. Explain why in some cases a bone marrow transplant is a better choice than a peripheral blood stem cells transplant and vice versa.

76. Describe the difference between acute and chronic graft-versus-host disease.

77. Analyze immunology quality control charts and devise a course of action to correct occurrences where the controls do not meet the QC rules.

78. Validate testing results.

79. Analyze lab results that do not correlate and determine a course of action to determine the cause of the lack of correlation.

80. Solve case studies involving immunological diseases where clinical symptoms are given along with laboratory testing results and either the diagnosis or listings of additional tests are requested.

81. Interpret immunofluorescence studies with regard to linear vs “lumpy, bumpy pattern” and correlate with the appropriate disease.

82. Analyze case studies and correlate these to the appropriate hypersensitivity reaction.

83. Describe and draw the three complement pathways. List the things that activate each individual pathway. Explain the functions of the various parts of all three pathways.

84. Explain what disease results from a deficiency of each complement component.

85. Describe the CD nomenclature and correlate to the appropriate cell type. Calculate the absolute CD 4, CD 8 or other designated cell type from other lab results to include total WBC count, percent of lymphocytes and percent of CD cell type.

86. Describe what influences the deposition of immune complexes in the tissues.

87. Explain what enhances the deposition of immune complexes in the tissues of experimental animals.

88. Analyze case studies and make judgments as to the appropriate lab test which will support the suspected diagnosis.

89. Describe diseases that affect the immunological responses of neutrophils to include G-6-PD Deficiency, Chediak-Higashi Syndrome and Chronic Granulomatous Disease.

90. Explain transplant immunology to include reasons for rejection, what immune mechanisms are involved in the rejection, how many days does it take for rejection to occur, and what immune elements may be found in the rejected organ.

91. Describe immunophenotyping by flow cytometry and identify the following CD designations:
    - B cells
    - T cells
    - NK cells
    - Lymphoid cells
    - Any others listed in class

92. Interpret hemagglutination, hemagglutination inhibition, latex agglutination, latex agglutination inhibition, precipitation, and any other characteristic immunology test results discussed in class to include the identification of the following:
    - Titer
    - Prozone
    - Postzone
    - Zone of equivalence
    - Validity of results
    - Invalid results
    - Quality control results

93. Correlate chemistry enzyme test results with a patient who has hepatitis such as AST and ALT results as well as other lab test results.

94. Describe the various rickettsial diseases and identify what organism causes the disease.

95. Analyze case studies giving test results for ANA, ASO, complement, and RA (as well as other immunology tests) and select the most likely disease in the patient.

96. Explain the policies and procedures recommended by OSHA regarding precautions to take when working with blood and body fluids in a lab.

97. Describe the precautions recommended by the CDC to avoid potential infection to lab workers.

98. Demonstrate the procedure for handling needles in the clinical lab.

99. Identify the various symbols utilized in the clinical lab for biohazard etc.

100. Name and describe MSDS sheets used in the lab by the employee.

101. Define and perform serial dilutions.

102. Calculate the concentration of a substance using the dilution factor.

103. Define antibody titer.

104. Calculate the concentration of a compound dilution.

105. Compare the characteristics of the acute and chronic phases of illness.

106. Calculate the value of a single dilution.

107. Calculate absolute cell count.

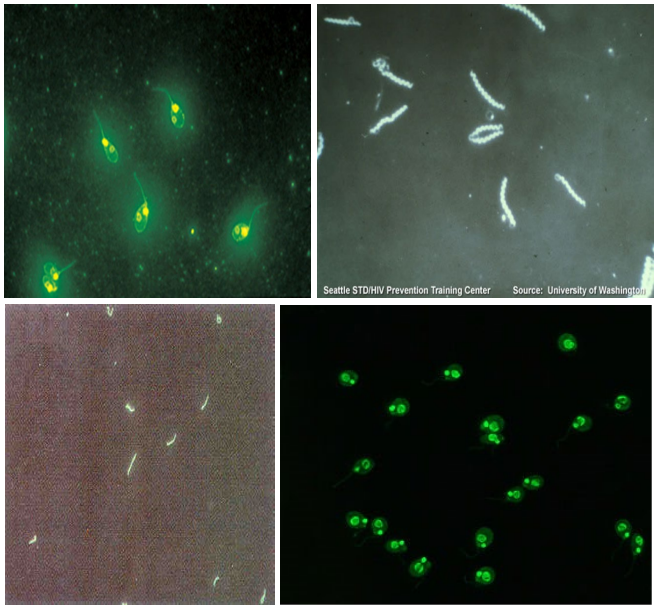
108. Understand the different types of vaccines.

109. Understand the mechanisms of different vaccines.

110. Understand the vaccine production process.

MT 401 – Clinical Immunology

(Revised 6/5/2026)



Instructor: Rebecca Thompson, B.S., MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, case studies, question and answer

Course Goal: To educate the student in clinical immunology so that they may function as an entry-level scientist in a clinical immunology laboratory.

Textbook: Turgeon, Mary Louise. Immunology & Serology in Laboratory Medicine. St. Louis, MO: Mosby Elsevier, 2025, 8th Edition, ISBN #978-0443122989.

Pre-Requisite Courses: One course in college level immunology and a minimum of three years of college.

CLINICAL IMMUNOLOGY LECTURE SCHEDULE

DATE:		TOPIC:	READING ASSIGNMENT:
6/16/26, 6/18/26, 6/23/26 & 6/25/26	I.	<u>The Immune System</u> a. Introduction to Immunology b. Antigens and Antibodies c. Immune Cells i. Phagocytic cells ii. Lymphocytic cells	Ch. 1 & 3 Ch.4
		d. Soluble Mediators of Immunity	Ch. 2
	II.	<u>Safety in the Serology Lab</u>	Ch. 5
6/26/26		**Exam 1**	
6/30/26, 6/30/26, 7/1/26	III.	<u>Techniques in Immunology & Microbiology</u> a. Antibodies and Serology Testing b. Dilutions c. Precipitation & Electrophoresis d. Agglutination e. Neutralization assays f. Labeled Immunoassays g. Complement Fixation h. Immunoblotting i. Nephelometry j. Tests for Complement k. Flow Cytometry l. Fluorescent ANA testing	Ch. 6 - 12 Micro text Ch. 10
7/1/26	IV.	<u>Immune Disorders</u> a. Hypersensitivity	Ch. 20
7/2/26		**Exam 2**	
7/10/26		b. Autoimmune Disorders i. Systemic Lupus Erythematosus ii. Rheumatoid Arthritis iii. Progressive Systemic Sclerosis iv. Hashimoto's Thyroiditis v. Grave's Disease vi. Sjogren's Syndrome vii. Myasthenia Gravis viii. Multiple Sclerosis ix. Diabetes Mellitus Type 1	Ch. 19 - 24

CLINICAL IMMUNOLOGY LECTURE SCHEDULE

DATE:	TOPIC:	READING ASSIGNMENT:
7/14/26 & 7/16/26	V. Immunology of Infectious Disease a. Immune Response in Infectious Disease b. Group A Strep Infections c. Rickettsial Disease d. *Mycoplasma pneumoniae* e. *Legionella* f. *Toxoplasma* g. Fungal Disease h. Syphilis i. Lyme Disease	Ch. 13 - 17
7/21/26	**Exam 3**	
7/23/26,	j. Viral Hepatitis k. HIV/AIDS	Ch. 18 - 19
7/28/26	l. HTLV m. Rubella n. Rubeola o. Epstein-Barr Virus p. Cytomegalovirus q. COVID	
7/31/26	Vaccines	Ch. 27
8/6/26	Review	
8/10/26	**Final Exam**	

Section 20

SRMH School of Medical Laboratory Science

MT 409 Education and Research

OBJECTIVES:

The MLS student will at the completion of the MT 409 Education and Research course, reading assignments, and practice in class giving a lecture with a minimum of 70% accuracy on a written or oral exam:

1. Define competencies and curriculum, and write behavioral objectives. Explain how all these and learning are interrelated to develop a curriculum.

2. List the qualities of a good teacher. Discuss how the teacher is a facilitator.

3. Explain the results of research as it applies to student expectations of a course.

4. Utilize competency-based education and task analysis as it relates to observation of performance and conversion of this into objectives and competencies.

5. List the responsibilities of a good teacher.

6. Write a behavioral objective for information given in class.

7. List the benefits of objectives for students.

8. List and define the three learning domains of Bloom to include cognitive, affective, and psychomotor.

9. Write objectives in the three learning categories utilized on the Board of Certification Exam to include recall, application, and problem solving.

10. Explain the six levels of learning in the Cognitive domain and correlate with the certification exam modified levels of three instead of six. Explain and write test questions at each level utilized in the certification exams.

11. List the levels in the Affective domain and explain how one progresses up the domain.

12. List the three levels of learning in the psychomotor domain.

13. Demonstrate a working knowledge of role playing by performing a scene in class from a pre-determined clinical setting. Explain how role playing can be used in an educational setting.

14. List the advantages and disadvantages of the various teaching techniques to include lecture, question and answer, discussion, role playing, demonstration, and doing.

15. List the advantages and disadvantages of computer-assisted instruction.

16. Write a description of teaching using the Internet and give advantages of this method.

17. List and write examples of the different types of evaluation to include multiple choice, essay, short answer, and matching. Explain which methods of evaluation are subjective or objective. Define subjective as compared with objective as it applies to test questions.

18. Write a lecture or teaching module complete with objectives, outline, and evaluation mechanisms.

19. Evaluate published studies as an informed consumer.

20. List the steps in the research process.

21. Explain the factors to consider when writing for publication in the clinical laboratory sciences.

22. Describe the use of statistics, both descriptive and inferential, with regard to research practice.

23. Identify the purpose of various types of research.

24. Give a five minute presentation to the class demonstrating good eye contact, speaking ability, and write objectives, competencies and test questions on this presentation. Correlate the objectives, competencies, and test questions for this presentation.

25. List the requirements of JACHO for hospital employees.

26. Discuss correlation coefficient and define the meaning of different numerical values.

27. Describe the different types of tests to include Norm-referenced and Criterion-referenced.

28. Identify the group of people that investigates research articles for publication.

29. Identify the general areas/Standards required by NAACLS to be included as part of the curriculum for a BS degree level such as HTL and MLS
30. Identify goals and compare them with objectives for a course of instruction.

31. Discuss the use of criticism in instruction.

Education MT 409 (Research Included)



Instructor: Abigail L. Blosser, B.S., MLS(ASCP)^{CM}

Method of Instruction: Lecture, discussion, question, and answer

Course Goal: To prepare the student to function as a beginning-level technologist/scientist who is able to draw blood, utilize computer systems, and solve problems in the laboratory.

Textbook: N/A

Lecture I 10/23/26 Online

I. *The Education Process*

A. Learning
B. The Teacher as a Facilitator
C. Qualities of a Teacher
    1. Student expectations of a course
    2. Teacher responsibilities
D. Behavioral Objectives (Educational Map)
    1. Competency-Based Education
    2. Task Analysis
    3. Benefits of objectives for students
    4. How to write an objective
E. Professional Competency: Hierarchical Domains
    1. Cognitive Domain
        a. Bloom vs. Board of Registry
    2. Affective Domain
        a. Attitudes
    3. Psychomotor Domain
        a. Hand to Eye coordination
F. Questions to answer and one problem to solve

II. *Research Design/Practice*

A. Introduction to Research: Process and Plan; Problem and Hypothesis
B. Writing a Proposal
C. IRB Process
D. External and Internal Validity
E. Research Design: Experimental & Quasi-experimental
F. Data Collection/Measurements & Instrumentation
G. Use of Statistics: Descriptive and Inferential
H. Selection and Interpretation of Statistical Tests
I. Dissemination and Critical Evaluation of Research
J. Writing for Publication in the Clinical Laboratory Sciences

Lecture II 10/27/26

I. *Teaching Methods*

A. Lecture
    1. Advantages and disadvantages (Handout)
B. Discussion
C. Teaching Via Electronic Media
    1. CAI—Computer Assisted Instruction
    2. Teaching Using the Internet
        a. Communication with patients

b. Drug searches
c. Disease states

D. Role Playing
E. Demonstrations
"A well-prepared demonstration is worth a million words."
F. Videos & Tapes
G. Distance Learning

II. *Types of Testing*

A. Objective vs. Subjective

1. Essay tests
2. Matching
3. Multiple choice
4. Short answer

III. Research

A. Statistical significance in a research study
1. "Effect Size"
B. Inferential Statistical Tests
C. Communications of research results
D. Collection Qualitative Data
1. Coding Qualitative Data
E. Publication Format
F. Evaluation of research paper

Class III Student Presentation **Due 11/2/26**

- Each student will give a 5 minute presentation to the class
  - Grading:
    - Overall presentation 10 points
    - Completeness of outline 5 points
    - Correctness of objectives 20 points
    - Objective correlation with test 20 points
    - Objectivity of test questions 20 points
    - Overall correlation (obj. test etc.) 25 points

  The topic must relate to laboratory medicine, but should be of special interest to you. You select your own topic.

  Total……100 points

Class IV Final Exam— **Due 11/4/26**

Section 21

MT 408 Clinical Laboratory Supervision and Management

OBJECTIVES:

The MLS student will at the completion of the lectures and classes, reading assignments, class participation and other assignments on management: (Measurement will be the attainment of a minimum of 70% on a written or practical exam, unless otherwise stated)

1. Describe the six management functions and relate each to management in the laboratory. List the management functions and define each one in detail.

2. Assess one's own leadership abilities with regard to the qualities presented in class.

3. Evaluate management scenarios given in class, and select the appropriate course of action in managing an employee or other problem.

4. Describe the characteristics of a good manager. Define a good manager and list specific characteristics to include personality types, communication skills, ability to organize, and knowledge of the area.

5. Distinguish effective management attributes from ineffective ones.

6. Describe a minimum of three types of plans, and relate these to managing the clinical laboratory.

7. Describe total quality management and relate it to the management of health care.

8. Prepare a flow chart to analyze the processing of specimens for the RMH Clinical Laboratory. Devise a plan to improve this flow of specimens.

9. Prepare a SWOT Analysis for the implementation of a “Point of Care” testing section for the RMH Laboratory Department.

10. Devise a plan for effective time management by utilizing the skills discussed in class.

11. Draw an organizational chart and define the direct lines of authority and indirect lines of authority.

12. Define organizing as it relates to management.

13. Explain the need for good customer service in health care today.

14. Describe one way to reengineer the process of accepting specimens and processing these specimens at the RMH Laboratory. The new process would result in a decrease in staff and money, thus an improvement to the bottom line.

15. Describe ergonomics and how it relates to computer use.

16. Explain the benefit of effective directing on personnel and productivity.

17. Demonstrate effective verbal communication and describe the need for such a skill in management. (Include the proper use of body language, facial expressions, silence, sounds, etc.)

18. Describe the barriers to effective communication.

19. Relate the need for motivation to effective management.

20. Describe Maslow’s hierarchy of human needs, and how an organization fulfills those needs.

21. Relate delegating to directing as it applies to good management.

22. Describe coaching as it relates to effective management.

23. Define controlling as it relates to timely and cost-effective attainment of an organization’s goals.

24. Analyze and revise a PFP (Pay for Performance) Standards Form for a position in the RMH Clinical Laboratory (Education Coordinator Position).

25. Describe a quality assurance program and its use in the clinical laboratory.

26. Utilize the PDCA (Plan, Do, Check, Act) cycle. (The Shewhart Cycle devised by Dr. W. Edwards Deming for use in the process of continuous quality improvement).

27. Describe the problem solving steps and utilize these steps to solve a management problem presented in class.

28. Describe the coordinating function of management.

29. Role-play an interview scenario utilizing the acceptable and lawful questions in an interview.

30 Discuss the multi-skilled worker, and the Americans with Disabilities Act (ADA).

31. Relate testing volumes to scheduling for staff.

32. Describe the federal government legislation related to hiring practices, regulation of laboratories, and personnel.

33. Draw an organizational chart showing the federal agencies that relate to health and human services.

34. Discuss registration, licensure, certification, and accreditation as it relates to the clinical laboratory.

35. Describe the test systems according to CLIA '88.

36. Discuss the agencies and associations associated with the clinical laboratory (AABB, AHA, CDC, CAP, COLA, DPH, FDA, HCFA, ISO, JCAHO, NCCLS, NIDA, OSHA, National Technical Information Services.)

37. Describe the government legislation related to medical practice to include Medicare, CLIA, OSHA, Stark I, 1989, Stark II 1993 and PPACA.

38. Utilize financial and accounting terms commonly used in the laboratory fiscal management to include:

- Profit and loss
- Cost/benefit
- Reimbursement requirements
- Materials/inventory management

39. Describe sources of laboratory revenues, and explain the challenges managers face in obtaining these revenues.

40. Define laboratory costs, and describe how each is used in calculating total expense, cost per test, and break-even numbers.

41. Evaluate cost containment strategies.

42. Define the basic principles of evaluation, and describe ways to assess the performance of laboratory personnel and laboratory-related activities.

43. Describe employee competency checks, and devise a competency assessment for a medical laboratory scientist and a histotechnologist.

44. Role-play a successful performance interview from a scenario given in class.

45. Calculate productivity ratios for a clinical laboratory for one month.

46. Describe outcomes management and outcome measures.

47. Define benchmarking and its application to management in the laboratory.

48. Describe laboratory marketing services, customer relations, guest relations, and develop a plan to handle and monitor customer complaints.

49. Describe the process of acquiring a laboratory information system.

50. Evaluate the usefulness of a laboratory information system.

51. Outline an article on the acquisition and evaluation of a laboratory information system, and describe the contents of the article to the rest of the class.

52. Utilize concepts and principles of laboratory operations as they apply to performance improvement.

53. Describe the dynamics of healthcare delivery systems as they affect laboratory service by reading and discussing the following summaries:

- The Health Care Delivery System: A Blueprint for Reform
- Integrated Health Care Delivery Systems' Challenges by Bonnie Boone

54. Describe the dynamics of healthcare delivery systems as they affect laboratory services, healthcare in the US and other countries, and current proposed changes by the Federal Government.

55. Demonstrate how critical pathways can be used in making clinical decisions and in planning for the future.

56. Utilize job descriptions in preparing a PACE form for a RMH employee who works in the lab. Demonstrate how these are used in the annual review process.

57. Define one FTE and calculate an annual salary when given pay per hour.

58. Utilize concepts and principles of motivational theories as they apply to performance improvement.

59. Describe a quality management system for continuously analyzing, improving and reexamining resources, processes and services within an organization.

60. Discuss the total testing process as a comprehensive working model for evaluating the components of the laboratory's quality management plan to include Preanalytical, analytical and post-analytical variables.

61. Discuss quality control as a method for establishing specifications for an analytical process, assessing the procedures, monitoring conformance by statistical analysis, and taking corrective actions to bring the procedures into conformance.

62. Define the essential components of a laboratory safety program

63. Evaluate the program for regulatory compliance

64. Identify hazardous materials and procedures in the laboratory.

65. Calculate the acceptable range for a control in the laboratory when the mean and standard deviation are given.

66. Analyze Levey-Jennings quality control charts by doing the following:
- Identify an upward and downward shift and trend
- Apply quality control rules to determine the possible cause of an error
- Correct an error

67. Calculate the mean, median, mode and standard deviation.

68. Calculate molarity, normality, molality, dilutions, conversions from mg% to mEq/L and from mEq/L to mg%, and conversions from one concentration to another.

69. Make a dilution from a concentrated stock solution correctly.

MT 408 Clinical Laboratory Supervision and Management



Instructor: Abigail Blosser, MLS (ASCP)^{CM}

Method of Instruction: Lecture, discussion, question and answer, role-playing, and the practice of the various management skills.

***Course Goal*:** To educate the student in all areas of laboratory management so that they may function as a beginning-level scientist/technologist with the projected ease of movement into future management positions in the clinical laboratory.

Textbook: Principles of Clinical Laboratory Management, by Jane Hudson, Printice Hall, 2004.

Henry's Clinical Diagnosis and Management by Laboratory Methods, by Richard A McPherson and Matthew R. Pincus, 2017.

Clinical Laboratory Management, by Lynne S. Garcia, 2014.

OTHER REFERENCES: "Management in Laboratory Medicine," by Snyder and Wilkinson, Lippencott-Raven Publishers, 1998.

"Medical Laboratory Management and Supervision," by Varnadoe, F. A. Davis, 1996.

"Total Quality Management in Healthcare," by D. H. Stamatis, McGraw Hill, 1996.

"Reinventing the Workplace," by David I. Levine, The Brookings Institution, 1995.

"Myths of Information Systems Selection," Braley Consulting Services, Inc.

"Information System Selection: There is a Better Way," Braley Consutling Services, Inc.

"Selection Process of a LIS," CLMA, 1999, CAP Today, Gary Braley.

Article: "Case Study: Information Systems," by Janet T. Headley, MT(NCA), Advance/Laboratory, May 2000.

Article: "Ten Steps To Better Time Management," by Rebecca Thimm, Advance/Laboratory, May 2000.

Article: "Charting A Course for Successful LIS Implementation," by Pamela Tarapchak, Advance/Laboratory, May 2000.

Article: "Sifting Through the Data to Find the Best LIS," by Judith A. O'Brien, MLO, Jan. 2001.

Pre-requisite courses: Three years of college to include the required courses for entry into the RMH Medical Laboratory Scientist School.

Instructions: Complete all weekly canvas assignments.

11/9/26 LECTURE I

I. Management Process and Managers
- A. Organizational Chart
- B. Management Concepts
  1. Management by Objectives
  2. Quality Management
- C. The Six Management Functions
- D. Managerial Roles
- E. Styles of Management
- F. Traits of Managers

II. Planning
- A. SWOT Analysis
- B. Components of Planning
- C. Flow Diagram of a Process
- D. Effective Time Management

III. Dynamics of Healthcare Delivery Systems
- A. Effect on Laboratory Service
- B. Systems in the United States

11/10/26 LECTURE II

III. Organizing
- A. Authority and Responsibility
- B. Reengineering a Laboratory Process
- C. Ergonomics
- D. Materials Management
- E. Organizing Activities and Events

IV. Directing
- A. Essential Skills of Directing
  1. Communication
     a. Verbal (Body Language)
- B. Motivating
  1. Maslow's Hierarchy of Human Needs
- C. Delegating
- D. Coaching

V. Controlling
- A. Work Standards
- B. Work Measures
- C. Quality Assurance
- D. Plan, Do, Check, Act (PDCA from Dr. W. Edwards Deming)

E. Decision Making and Problem Solving

11/11/26 **LECTURE III**

VI. Laboratory Information Systems
- A. System Components
- B. Software and Networks
- C. Hardware
  - 1. Hospital Information System
- D. Interface software

VII. The Electronic Medical Record

VIII. The Acquisition and Evaluation of Laboratory Information Systems
- A. Define System Requirements
- B. Request Bids
- C. Demonstrations
- D. Staffing
- E. Implementation
- F. Standard Operating Procedures
- G. Data Security
- H. Data Retention

11/13/26 **EXAM**

11/16/26 **LECTURE IV**

IX. Coordinating
- A. CLIA 1988
- B. Multiskilled Workers
- C. Government Legislation Affecting Labs
  - 1. Diversity and the Americans with Disabilities Act
  - 2. Government Regulation and Standards as Applied to Lab Practice
- D. Scheduling and Teams
- E. Critical pathways, PERT and planning techniques
- F. Federal Government Legislation Related to Hiring Practices

X. Total Quality Management and Quality Assurance/Quality Improvement
- A. Basic requirements
- B. Team Building Skills and Uses
  - 1. Continuous Improvement
  - 2. Performance Improvement
- C. Basic tools of TQM
  - 1. Cause and Effect Diagram (fishbone diagram)
  - 2. Dispersion Analysis Diagram
- D. Principles and Practices of Quality Assurance/Quality Improvement
  - 1. Pre-analytical, Analytical, and Post-analytical Components of Laboratory Services
- E. Take Home Assignment

XI. Federal Government Legislation Related to Hiring Practices

11/17/26 LECTURE V

XII. Managing Finances

A. Basic Financial Management

B. Profit and Loss

C. Revenue, Operating Costs, Capital Costs, Cost Management, Cost Analysis

1. Cost Per Test
2. Break Even Analysis
3. Cost Accounting and Cost Containment
4. Reimbursement Requirements
5. Materials and Inventory Management

XIII. Evaluating and Personnel Management

A. Basic Principles of Evaluation

B. Personnel Evaluation and Human Resource Management

1. Performance Standard/Evaluation
    a. Utilization of Personnel
    b. Analysis of Workflow and Staffing Patterns
2. Competence Assessment
3. Performance Appraisals (PFP) and Position Description
4. Performance Interview
5. Evaluation of Activities
6. Laboratory Productivity Measures
7. Outcomes Management

XIV. Benchmarking

XV. Marketing Services

A. Customer Service, Guest Relations

XVI. Clinical Decision Making

XVII. Dynamics of Healthcare Delivery Systems

A. Affect on Laboratory Service

B. Healthcare Delivery in US versus Other Countries

C. Current Changes Proposed by Federal Government

11/18/26 LECTURE VI

XVIII. Quality Management

A. Analyzing, Improving, reexamining resources, processes and services

XIX. Quality Assessment

A. Total Quality Plan

B. Total Testing Process

1. 3 Phases
    a. Preanalytical

b. Analytical
c. Post analytical

XX. Quality Improvement Tools
- A. Q-Probes
- B. Q-Tracks
- C. Quality Control
  - a. Deviation
    - i. Systemic
    - ii. Random
  - b. Frequency
- D. Levey-Jennings Charts
  - a. Westgard Rules
- E. External QC (Proficiency Testing)

XXI. Quality Management of Post analytical Processes
- A. Time Sensitive
- B. Test Selection & Implementation
  - a. Waived
  - b. Non-waived

XXII. Current Regulations
- A. Four Horsemen
  - a. CLIA ’88
    - i. FDA
    - ii. CMS
    - iii. CDC
  - b. HIPPA
  - c. OSHA
  - d. Stark
- B. Long-Term Effects: Legislation, Regulation, Accreditation
- C. Healthcare Reform
  - a. PPACA
  - b. Current Trends and Issues with Healthcare Reform

11/19/26 LECTURE VII

XXIII. Safety Management Plan & Responsibilities
- A. Standard Precautions
- B. PPE
- C. Engineering
- D. Design
- E. Vaccination
- F. Hazardous waste
- G. Safety Devices

XXIV. Laboratory Hazards
- A. Biological
  - a. Transmission

b. LAIs
B. Chemical
a. Classification
b. Exposure
C. Physical
D. Radiological
a. Risk
i. Time
ii. Distance
iii. Shielding

XXV. Standard Precautions
A. OSHA

XXVI. Hazard Prevention and Containment
A. Risk Assessment
a. Exposure Control Plan
b. WHO
c. CDC/NIH
d. Biosafety Lab
B. Handwashing
C. Barrier Protection
D. Engineering Controls
E. Chemical Fume Hoods
F. Biological Safety Cabinets
G. Sterilization and Decontamination
a. Germicides
b. Disinfectant
c. Sterilization

XXVII. Spill Management

11/20/26 **FINAL EXAM**