CLINICAL LABORATORY SCIENCE 131/132/133

COURSE DESCRIPTION

CLSC 131: Introduction to Hematology
Introduction to venous and micro blood collection techniques, Introduction to basic hematology theory and laboratory procedures. College competency required in the performance of venous and micro blood collection, normal WBC differentials, Erythrocyte Sedimentation Rates, manual cell counts, and reticulocyte counts (A special fee will be assessed).

Prerequisite: High School algebra or equivalent.

Corequisite: CLSC 111, CLSC 112, and CLSC 133

Credits: 2 Semester Hours

CLSC 132: Urinalysis and Body Fluids
Body Fluid cell counts and chemical analysis, and basic urinalysis theory and procedures. College competency required in the performance of routine urinalysis, and CSF cell counts. (A special fee will be assessed)

Prerequisite: CLSC 131

Corequisite: CLSC 111, CLSC 112, and CLSC 133

Credits: 2 Semester Hours

CLSC 133: Hematology I/ Urinalysis Clinical Practicum
Clinical practicum in Hematology and Urinalysis at an affiliated clinical agency. Clinical competency required in the performance of venous and micro blood collection, routine urinalysis, body fluid cell counts, normal WBC differentials, Erythrocyte Sedimentation Rates, manual cell counts, and reticulocyte counts.

Prerequisite: High School algebra or equivalent

Corequisite: CLSC 111, CLSC 112, CLSC 131, and CLSC 132

COURSE PLACEMENT IN THE PROGRAM

Fall Semester, First Year

FACULTY

Instructor: Mrs. Cheryl Selvage, MS, MT (ASCP)
HS210E 440-366-4139
cselvage@lorainccc.edu

College Laboratory Instructor: Mrs. Melanie Forren, BS, MT (ASCP)

Clinical Faculty: Mr. Eric Slavik, MLT (ASCP)
Mr. Ed Seymore, MT (ASCP)
Ms. Ginger Weaver, MT (ASCP)
Ms. Vicky Roth, MT (ASCP)

Division of Allied Health and Nursing Dean: Dr. Frank Ward

PROGRAM POLICIES

Students are responsible for conforming to the policies contained in the ***CLS Program Student Handbook***. Students are urged to review these policies again, since they will be enforced on campus and at the clinical site.

ACCOMMODATION STATEMENT

A student with a disability who desires special accommodation must inform the Office of Special Needs of their disability and need for accommodation. The reason for this is to provide support services to enable a qualified student to be successful. If you are a person with a disability who needs accommodations or assistance, contact the O.S.N.S. located in Room 115 in the Learning Resource Center (Theo Scott, Coordinator, ext. 4058).

ACADEMIC POLICIES

1. Students failing to score at least 77% (overall) in both the lecture and college lab portions of CLSC 131, CLSC 132, CLSC 111, and CLSC 112, will not be permitted to enter CLSC 134. Students must receive a satisfactory (Pass) in CLSC 133 to enter CLSC 134. Students must receive a passing grade in CLSC 131 and 132 in order to receive a satisfactory grade in CLSC 133.

2. There will be three quizzes and one final exam in CLSC 131 and CLSC 132 respectively. Examination/ Quiz make-ups will be made at the discretion of the instructor and may require a physician's statement documenting student illness. Students who cannot take exams as scheduled due *to personal conflicts* (dentist, babysitters, car problems, etc.) are to ***schedule the test ahead of schedule*** with the instructor.

   If a make up quiz is allowed, there will be a one point penalty for each day that has passed since the date the quiz was originally given and the student will be ineligible for the bonus questions on the quiz.

   Exams/ Quizzes **missed due to tardiness** will be treated the **same as an absence** and will follow the same policy as written above. Once the exam is distributed, no one will be permitted to enter the room.

3. One Final Exam, worth 150 points, will be given in each course. If the Exam is taken late, **five points** will be deducted from the score of the Exam for **each day** that has passed since the date the Exam was originally given. In addition, the student will not be

permitted to complete any "extra credit" questions that were part of the original version of the Exam.

4. College Laboratory Policy: The purpose of College Laboratory sessions is to provide students the maximum opportunity to learn and master clinical testing principles and procedures free of the pressures of the actual clinical setting.

   Completion of assigned College Laboratory activities is evaluated on a ***Satisfactory/ Unsatisfactory*** **basis.** ***All College Laboratory reports are due no later than one week after each Rotation.*** Worksheets and/or assigned objectives must be thoroughly completed to the satisfaction of the instructor for a student to be considered satisfactory in College Laboratory performance. Students will be required to keep a Laboratory Notebook.

   Students may be required to repeat College Laboratory procedures if the test performance or results obtained are considered unsatisfactory by the instructor. Incorrect or incomplete worksheets will be returned to the student for satisfactory completion of the assigned work. Failure to submit all assigned College Laboratory work ***ON TIME***, and completed to the satisfaction of the instructor, will result in an ***Unsatisfactory College Laboratory grade*** and the letter grade for the course ***will be lowered by one grade*** (i.e., an 'A' becomes a 'B', a 'B' becomes a 'C', a 'C' becomes a 'D'). Any Laboratory work not completed to the satisfaction of the instructor by the final exam date will result in an "incomplete" for the course. Students cannot continue in CLSC 134 with an incomplete in either CLSC 131 or 132.

5. Completion of assigned Clinical objectives is evaluated on a ***Satisfactory/ Unsatisfactory*** **basis.** Any student evaluated, as clinically Unsatisfactory prior to the last day to withdraw will be counseled to withdraw from the Program. If this student does not withdraw, or if the clinical grade of Unsatisfactory is assigned after the last day to withdraw, the **Unsatisfactory** grade will result in the grade of "F" for the course, regardless of performance on lecture quizzes and exams, and the student will not be permitted to continue on in the Program.

TARDINESS POLICY

Being late to lecture is an indication of rudeness and lack of respect for your professor as well as your classmates, and represents unprofessional conduct on the job. If a student arrives after lecture has begun, the student will not be admitted into the classroom until the professor releases the class for a break. **Students are not to enter the classroom once class has begun. It is disruptive to the learning and concentration of their classmates and disrespectful to the instructor.**

FINAL GRADE EVALUATION

The CLSC 131, and 132-course grades will be calculated based on the total points scored by the student (assuming Clinical and College Laboratory grades of Satisfactory). The grading scale appears in the CLS Student Handbook and on page 7 of this syllabus.

A copy of the GRADE FORM for CLSC 131 and 132 appears on page 7 of the syllabus. It details the point values for each portion of the course and the number of total points, which must be earned for each final course letter grade. Students should record their quiz and exam scores on the GRADE FORM as the semester progresses to monitor their course grade status.

ANGEL INSTRUCTIONS FOR ACCESSING GRADES

- ANGEL works best with Internet Explorer (may not always work with Netscape)
- From the LCCC home page (www.lorainccc.edu) click on ***Angel Login***
- When the Angel page comes up, bookmark it as one of your ***Favorites***
  (The Angel website does not reside on the LCCC server and does not have to be accessed through the LCCC website. If you have it bookmarked you can access it even when the LCCC server is down.)
- Before attempting to log onto Angel, be sure to read ***Required Angel Technical Settings*** on the web page. You may need to change some settings in your browser in order for Angel to work (unblock cookies, etc.).
- Log onto Angel with your Student Number and password.
  When logging onto Angel for the first time, your ***LCCC ID Number*** and ***Password*** are both your LCCC student number. You will then be prompted to change your password after login.
- From your personal Homepage, click on the appropriate course.
- On the Course page, click on ***Report*** (the last tab on the top right of the page).
- On the ***Reports Console*** page, choose ***Grades*** in the ***Category*** drop-down window.
- Click ***Run*** in the lower right corner of the displayed page.
- Your grades for the entire course will now be displayed, including your overall average course grade with your lowest quiz score dropped. You will need to scroll down through the grade page to see everything.

  NOTE: Because the grade book is set up to drop your lowest quiz score, when you have only taken Quiz #1, your overall average score will display as 0% (F). The grade book is dropping your Quiz #1 score. DON'T PANIC! Your overall grade will be correct after Quiz #2 is entered!

  NOTE: Angel is also used to convey information to the class in the form of announcements. Please check angel prior to class on a weekly basis.

  Please use the LCCC email address: cselvage@lorainccc.edu and not angel for remarks or questions.

ELECTRONIC DEVICE POLICY

If electronic devices such as pagers and cellular telephones go off during class, it is disruptive to the educational process, as well as disrespectful to the instructor and fellow classmates. For this reason, use of these devices during class time is PROHIBITED. Students are to TURN OFF their cellular phones and pagers when entering class and store them away. ***There are to be no phones, pagers, PDAs, or any other electronic devices on the desktop during class, quizzes, or exams. THE USE OF CELL***

PHONES AND PAGERS IS ALSO PROHIBITED DURING ASSIGNED CLINICAL HOURS. If a student's cell phone or pager goes off during class, the student will be expected to ***leave class immediately and will not be permitted to return that day***. If a quiz or exam is being taken, the student will be required to turn in the quiz / exam immediately and leave class, accepting the grade based on the points scored on the portion of the quiz / exam completed.

CALCULATOR POLICY

Students will be provided with the type and model of an acceptable calculator for the CLSC program in CLSC 121. This model will be the **only permissible** calculator for exam days. Students **may not share** calculators during exams. If you forget your calculator or if you choose not to purchase the acceptable model, you will not have access to a calculator during the exam.

ACADEMIC INTEGRITY

Students caught cheating on any examination or laboratory assignment will be subject to disciplinary action. "Cheating" is defined by ***irregular behaviors*** as observed by Program faculty that include but are not limited to: copying a classmate's answers to test questions or laboratory worksheet questions, allowing a classmate to copy one's answers to test questions or laboratory worksheet questions, looking at a classmate's paper during a quiz or exam *or giving the appearance of looking around the room during a quiz or exam*, falsifying laboratory results, and plagiarism of writing from another source.

Quizzes and Exams: Anyone caught cheating on a quiz or exam will be given a score of **"zero"** for that quiz or exam, and be issued a **written Deficiency Notice** documenting the incident. If a student is caught cheating on a quiz or exam a second time, they will be **immediately dismissed** from the Program and receive a grade of "F" for the course.

College Laboratory: Anyone caught not doing their own work in the college laboratory (bench testing or written assignments) will be given a written Deficiency Notice documenting the incident and be expected to repeat that laboratory assignment. If a student is caught cheating in the college laboratory a second time, they will be immediately dismissed from the Program and receive a grade of "F" for the course. If written answers to worksheet questions are too similar from two different students, ***both students will be disciplined for cheating according to this policy.*** Students are to answer college laboratory worksheet questions independently and in their own words!

Clinical Assignments: Anyone caught lying or cheating in any way at their clinical site will be given an Unsatisfactory (U) clinical grade and immediately dismissed from the clinical site.

OFFICE HOURS

Mrs. Selvage will post (HS210E) five office hours per week and be available during these times. Students should know that Mrs. Selvage will make herself available to any student needing help for as much time as necessary at a mutually agreeable time, regardless of posted office hours. Mrs. Selvage can be reached by Telephone: 440 – 366-4139. Email: cselvage@lorainccc.edu.

Student Grading Form CLSC 131

	Student Score	Possible Score
Quiz 1		20
Quiz 2		20
Quiz 3		20
Final Exam		150
Total Points		210

Student Grading Form CLSC 132

	Student Score	Possible Score
Quiz 1		20
Quiz 2		20
Quiz 3		20
Final Exam		150
Total Points		210

CLSC 131/132 Course Grading Scale:

93 - 100%	A
85 - 92%	B
77 - 84%	C
69 - 76%	D
0 - 68%	F

Course Outcomes:

Cognitive Outcomes

At the end of CLSC 131/132/133, the student will be able to:

1. Describe the principles, procedures, and equipment involved in the collection of venous and capillary blood specimens for laboratory testing.

2. Predict potential complications that can occur during the procedures of venous and capillary blood collection and the appropriate resolution of complications.

3. Describe principles and procedures of tests performed in a clinical laboratory in the areas of Urinalysis, Basic Hematology, and Body Fluid analysis.

4. Relate normal and abnormal laboratory test results to their corresponding clinical significance.

Psychomotor Outcomes:

5. Demonstrate satisfactory entry-level skill at the Medical Laboratory Technician/ Clinical Laboratory Technician level in the collection of venous and capillary blood specimens for laboratory testing.

6. Operate and maintain laboratory instruments used in the performance of tests in the areas of Urinalysis, Basic Hematology, and Body Fluid analysis with entry-level skill at the Medical Laboratory Technician/ Clinical Laboratory Technician level.

7. Demonstrate satisfactory entry-level skill at the Medical Laboratory Technician/ Clinical Laboratory Technician level in the performance of laboratory tests in the areas of Urinalysis, Basic Hematology, and Body Fluid analysis.

Affective Outcomes:

8. Demonstrate decision-making/ problem solving skills in the performance of Urinalysis, Basic Hematology, and Body Fluid test procedures.

9. Demonstrate an ethical and professional attitude in all aspects of their course performance, adhering to all program policies and procedures as delineated in the Program Student Handbook.

REQUIRED TEXTBOOKS:

CLSC 131

* *Hematology Clinical Principles and Applications*, 3rd edition Bernadette F. Rodak, Saunders Company, 2007.

**Clinical Hematology Atlas*, 3rd edition, Jacqueline H. Carr, Bernadette F. Rodak, Saunders Company, 2008

CLSC 132

**Fundamentals of Urine & Body Fluid Analysis,* 2nd edition, Nancy Brunzel, Saunders Company, 2004.

REFERENCE TEXTBOOKS

**Hematology in Practice*, Betty Ciesla, F.A. Davis Company, 2007

**Clinical Hematology Theory and Procedures*, 4th edition, Mary Louise Turgeon Lippincott Williams & Wilkins, 2005

**Clinical Laboratory Hematology,* Shirlyn B. McKenzie, Prentice Hall, 2003

**Clinical Hematology and Fundamentals of Hemostasis,* 4th edition, Denise M. Harmening, F.A. Davis Company, 2001.

**Clinical Hematology : Principles, Procedures, Correlations*, 2nd edition, E. Annne Stiene-Matin, Cheryl A. Lotspeich-Steininger, John A. Koepke, Lippincott, 1998

**Hematology: Principles and Procedures*, 6th edition, Barbara A. Brown, Lea & Febiger, 1993.

**Clinical Diagnosis and Management by Laboratory Methods*, 21st edition, Henry, Saunders, 2007

* *Saunders Manual of Clinical Laboratory Science*, Craig Lehmann, Saunders Company, 1998

* *Urinalysis and Body Fluids*, edition 4, Strasinger and Di Lorenzo, F.A. Davis, 2001

**Urinalysis and Body Fluids A Color Text and Atlas*, Karen Ringsrud and Jean Linne, The Mosby Company, 1995

**Textbook of Urinalysis and Body Fluids*, Landy J. McBride, Lippincott, 1998

**A Handbook of Routine Urinalysis,* Sister Laurine Graff, J.B. Lippincott Company, 1983

**Phlebotomy, Worktext and Procedures Manual,* Sommer Warekois, Saunders Company, 2002.

LCCC GENERAL EDUCATION OUTCOMES

Recognizing the responsibility of the Clinical Laboratory Science Technology Program to address the General Education outcomes established by the College, the content of this course has been developed to include these Outcomes:

LCCC Infused Outcome #1: Critical Thinking – Employ critical thinking skills in addressing issues and problems.

LCCC Infused Outcome #2: Communication – Demonstrate competence in verbal and nonverbal communication.

LCCC Infused Outcome #4: Ethics – Apply personal, professional, social, and civic values.

See the complete LCCC General Education Policy in the current College Catalog.

CLSC 131/131 2008 LECTURE SCHEDULE

Lecture Times: Mondays 10:00 – 11:50 a.m.
Wednesdays 2:00 – 3:50 p.m.

WEEK	LECTURE DATES for CLSC 131		TOPIC
1	August 18 August 20	(Monday) (Wednesday)	Introduction to the Course Syllabus; Handbook Venipuncture
2	August 25 August 27	(Monday) (Wednesday)	Venipuncture Venipuncture
3	**September 1** September 3	**(Monday)** (Wednesday)	**LABOR DAY [CAMPUS IS CLOSED]** **Quiz #1;** Red Cell Maturation
4	September 8 September 10	(Monday) (Wednesday)	Red Cell Maturation Red Cell Maturation
5	September 15 September 17	(Monday) (Wednesday)	**Quiz #2;** Red Cell Maturation White Cell Maturation
6	September 22 September 24	(Monday) (Wednesday)	White Cell Maturation White Cell Maturation
7	September 29 October 1	(Monday) (Wednesday)	**Quiz #3;** White Cell Maturation White Cell Maturation
8	October 6 October 8	(Monday) (Wednesday)	White Cell Maturation**;** Platelet Maturation Hemoglobin; Hematocrit, and ESR
9	**October 13**	**(Monday)**	**Final Exam**

CLSC 131/131 2008 LECTURE SCHEDULE

Lecture Times: Mondays 10:00 – 11:50 a.m.
Wednesdays 2:00 – 3:50 p.m.

WEEK	LECTURE DATES for CLSC 132		TOPIC
1	October 15	(Wednesday)	Urinalysis
2	October 20 October 22	(Monday) (Wednesday)	Urinalysis Urinalysis
3	October 27 October 29	(Monday) (Wednesday)	**Quiz #1;** Urinalysis Urinalysis
4	November 3 November 5	(Monday) (Wednesday)	Urinalysis Urinalysis
5	November 10 November 12	(Monday) (Wednesday)	**Quiz #2**; Urinalysis Cerebral Spinal Fluid
6	November 17 November 19	(Monday) (Wednesday)	Synovial Fluid Synovial Fluid; Semen Analysis
7	November 24 November 26	(Monday) (Wednesday)	**Quiz #3**; Semen Analysis Effusions
	November 27 – 28	(Thurs/Fri)	**Thanksgiving Holiday** **Campus is closed**
8	December 1 December 2,3	(Monday) (Tues/Wed)	Amniotic Fluid **READING DAY [NO CLASSES]**
9	December 8 December 10	(Monday) (Wednesday)	Hematology/ Body Fluid Review **Final Exam**

CLINICAL LABORATORY SCIENCE 131
LECTURE OUTLINES AND OBJECTIVES

LECTURE 1: VENIPUNCTURE

I. Venipuncture

A. Importance

B. Inspiring Confidence

C. Building Self-Confidence

II. Blood

A. Blood-Tissue

B. General function
1. Red Blood Cells
2. White Blood Cells
3. Platelets

C. Composition

D. Types of leukocytes
1. Granulocytes
2. Agranulocytes

E. Normal Reference Values
1. Red Blood Cells
2. White Blood Cells
3. Platelets

F. Plasma composition

G. Blood specimen
1. Whole blood
2. Plasma
3. Serum

H. Anticoagulants

I. Drawing order

J. Department preference

III. Sites for Venous Collection

A. Forearm
B. Hand/Wrist
C. Foot
D. Femoral Artery

IV. Venipuncture Sites to Avoid

- A. Scars
- B. Mastectomy
- C. Hematoma
- D. I.V.
- E. Fistula
- F. Cannula
- G. Arteries

V. Safety Precautions

VI. Blood Collection Procedure

- A. Organization
- B. Patient Identification
- C. Preparation of Equipment
- D. Preparation of Patient
- E. Venipuncture Technique
- F. Inverting Anticoagulated Samples
- G. Labeling of Specimens
- H. Clean-Up
- I. Care of Patient
- J. Departure

VII. Timed Blood Specimens

- A. Therapeutic Drug Monitoring
- B. OGTT

VIII. Complications in Blood Collection

- A. I.V.
- B. Syncope
- C. Failure to Draw Blood
    1. Needle Position
    2. Vacuum
    3. Hematoma
    4. Edema
    5. Hemoconcentration
    6. Seizure
    7. Nausea
    8. Refusal
    9. Missing Patient
    10. Patient Reaction
    11. Isolation

IX. Factors Affecting the Specimen

A. Physiological
B. Hemolysis
    1. Definition
    2. Causes
    3. Affected Tests

X. Quality Control

A. Definition
B. Specimen Rejection
C. Responsibility

XI. Micro Skin Puncture

A. Types of Patients
B. Sites
C. Laboratory Tests

LECTURE 1: VENIPUNCTURE

OBJECTIVES:

At the end of this unit, the student will be able to:

1. Describe why blood drawing is important.
2. Identify four ways, in which you can inspire confidence in the hospital patients that you draw.
3. Describe ways in which to gain confidence in your own ability.
4. Explain the reason for blood to be classified as a tissue.
5. Identify the specific type of tissue associated with blood.
6. Describe, in detail, the function of the specific cell types and amount of blood in an adult.
7. Name the three general classifications of formed elements (cells) in blood and describe their function.
8. Define the medical root words associated with the formed elements in blood.
9. Describe the composition of blood.
10. Name the types of white blood cells normally found in peripheral blood.
11. Define the medical root words associated with leukocytes found in peripheral blood.
12. List the normal reference values (numbers) for all the formed elements in blood.
13. Identify the chemical composition of blood plasma.
14. Differentiate between the three forms in which blood is generally tested in the laboratory, and identify those forms, which contain fibrinogen.
15. Describe the color, effect, mode of action, precautions, and use of the commonly used anticoagulants in the B-D Hemogard closure system.
16. Arrange the types of blood collection tubes in their proper blood drawing order.
17. Name the blood collection tubes most commonly used in the different laboratory departments.
18. Describe the various venous sites from which blood may be drawn and those sites to avoid.
19. Explain the safety precautions a phlebotomist must take in performing blood-drawing procedures.

20. Describe in detail the chronological order of the collection of blood from a patient. Emphasis on following:
    a. organization
    b. patient identification
    c. preparation of equipment
    d. preparation of patient
    e. venipuncture technique
    f. inverting anticoagulated samples
    g. disposal of contaminated needle
    h. labeling of specimens
    i. clean up
    j. care of patient after venipuncture
    k. remove gloves/wash hands
    l. departure from room

21. Explain what is meant by a "timed" specimen.

22. Describe the glucose tolerance test (GTT).

23. Identify the blood collection tube used for drawing GTT samples and explain why this tube is used.

24. Identify several complications found in blood drawing and propose solutions to solve these difficulties.

25. Identify which physiological factors can have an affect on laboratory specimens and which tests they affect.

26. Discuss ways in which hemolysis occurs and how hemolysis can be prevented.

27. Identify the most common cause of hemolysis.

28. Identify those tests, which are most influenced by hemolysis and describe how they are altered.

29. Discuss the role and responsibility of laboratory personnel in the acceptance and rejection of laboratory specimens.

30. Propose four reasons for collecting micro skin puncture blood samples.

31. Identify the most common sites for obtaining micro skin puncture samples from patients.

32. Identify the tests, which are part of Ohio's Newborn Screening Program.

LORAIN COUNTY COMMUNITY COLLEGE
DIVISION OF ALLIED HEALTH & NURSING
CLINICAL LABORATORY SCIENCE TECHNOLOGY AND PHLEBOTOMY

VENIPUNCTURE

CHECKLIST

Student's Name: _____ Date _____

VENIPUNCTURE OBJECTIVES: The student:	**Performed**	**Performed, Needs More Practice**	**Not Performed**
1. Greets the patient in a friendly, tactful manner.			
2. Identifies self and explains the procedure to the patient.			
3. ***Identifies the patient by using the two-step method of patient identification.**			
4. Dons gloves on DOMINANT hand.			
5. Assembles the needle to the holder/ Safety Device			
6. Selects appropriate blood drawing materials to bring to the patient's bedside.			
7. Places the blood drawing materials on the appropriate side of the patient's arm.			
8. Ties the tourniquet smoothly and tightly.			
9. Has the patient close their hand to make a fist.			
10. Selects an appropriate vein within a reasonable amount of time.			
11. Dons glove on NONDOMINANT hand.			
12. Cleanses the venipuncture site with the appropriate antiseptic in the appropriate manner.			
13. Cleanses gloved index finger of the NONDOMINANT hand with the antiseptic.			
14. Inserts the FIRST evacuated collection tube into the Vacutainer Holder/ Safety Device			
15. Removes the needle sleeve carefully, rotates the Vacutainer Holder so the needle bevel is in the ***UP*** position.			
16. Holds the Vacutainer Holder using an appropriate hand position.			
17. Performs the venipuncture technique smoothly following these steps: a. ***FEELS*** the vein again with the NONDOMINANT index finger *ABOVE* the intended puncture site.			
b. ***MARKS*** the intended site with the needle tip without touching the patient's skin with the needle, approximately ¼ inch *BELOW* the intended puncture site.			
c. ***ANCHORS*** the vein appropriately with the NONDOMINANT thumb and/or index finger.			
d. ***STICKS*** the vein with a smooth and quick motion.			

VENIPUNCTURE [Continuation] Objective: The student:	Performed	Performed, Needs More Practice	Not Performed
18. Squeezes the FIRST evaluated collection tube onto the rear end of the needle in the Vacutainer Holder without moving the needle in the patient's arm.			
19. Calmly moves or changes the position of the needle if blood does *NOT* flow into the FIRST evacuated collection tube in the appropriate manner.			
20. When blood begins to flow into the FIRST evacuated collection tube, has the patient relax their hand.			
21. Fills the evacuated collection tubes in the correct order, and changes tubes smoothly without moving the needle.			
22. ***Releases the tourniquet *BEFORE* removing the needle.**			
23. Removes the last filled evacuated tube from the Vacutainer Holder ***BEFORE*** withdrawing the needle from the patient's arm.			
24. Places a cotton ball or gauze pad gently over the puncture site, then withdraws the needle smoothly from the patient's arm, applying pressure to the site with the cotton ball or gauze pad ***AFTER*** withdrawing the needle.			
25. ***Uses safe technique to click the safety device closed on a hard surface without using fingers.**			
26. ***Properly disposes of the Needle-Safety Device Assembly in a puncture –resistant sharps container.**			
27. Has the patient hold the puncture site.			
28. Picks up the blood-filled evacuated collection tubes and inverts them.			
29. Labels all blood-filled evacuated collection tubes appropriately.			
30. ***Checks the patient's puncture site and applies bandage if appropriate.**			
31. Cleans up all supplies and waste from the patient's bed, and discards waste in appropriate containers.			
32. Re-secures bed railings if they were put down.			
33. Removes gloves			
34. Washes or Sanitizes Hands			
35. Leaves patient courteously			

***While failure to perform any of the required steps in the venipuncture procedure can result in an unsuccessful draw, those marked with an asterisk (*) indicate critical steps. If not performed appropriately will be designated as unsuccessful and will not count towards the required venipuncture quota or competency check-off, regardless of the number of tubes of blood drawn.**

LECTURE 2: RED BLOOD MATURATION

I. Red Blood Cell Maturation

A. Site of Development
1. Mesoblastic Period
2. Hepatic Period
3. Adulthood

B. Bone Marrow
1. Types
2. Production sites

C. Terminology
1. Hematopoiesis
2. Erythropoiesis
3. Medullary Hematopoiesis
4. Extramedullary Hematopoiesis

D. Origin of Blood Cells

E. General Maturation Characteristics

F. Erythropoiesis
1. Pronormoblast (Rubriblast)
2. Basophilic Normoblast (Prorubricyte)
3. Polychromatophilic Normoblast (Rubricyte)
4. Orthochromatic Normoblast (Metarubricyte)
5. Reticulocyte (Polychromatophilic Erythrocyte)
6. Erythrocyte

G. Types of Erythropoiesis
1. Normal Erythropoiesis
2. Megaloblastic Erythropoiesis
3. Microcytic Erythropoiesis

H. Regulation
1. Erythropoietin
2. Positive Influences
3. Results of Positive Influence
4. Reticulocyte Count
   a. purpose
   b. methods
   c. staining
   d. calculation
   e. reference ranges
   f. clinical significance
   g. sources of error
   h. other calculations

II. Erythrocyte Structure
A. Morphology
1. Biconcave

2. Poikilocytosis
a. Types
1. Discocytes
2. Echinocytes
3. Acanthocyte
4. Codocyte
5. Drepanocytes
6. Elliptocytes
7. Schistocytes
8. Dacryocytes
9. Keratocytes
10. Stomatocytes

3. Anisocytosis
a. Types
1. Normocytes
2. Microcytes
3. Spherocytes
4. Macrocytes

B. Staining Quality
1. Normochromic
2. Polychromasia
3. Hypochromasia

C. Erythrocyte Inclusions

a. Types
1. Basophilic Stippling
2. Howell-Jolly Bodies
3. Cabot Rings
4. Siderocytic Granules
5. Heinz Bodies
6. Malaria
7. Crystals

LECTURE 2: RED BLOOD CELL MATURATION

OBJECTIVES

At the end of this unit, the student will be able to:

1. identify the site of development of the blood elements in the following developmental periods:
   a. Mesoblastic Period
   b. Hepatic Period
   c. Adulthood

2. differentiate between red bone marrow and yellow bone marrow.

3. list the sites of red bone marrow production and the two most common sites for obtaining red bone marrow samples (aspirations) from adults and children.

4. define the term's "hematopoiesis" and "erythropoiesis."

5. define the prefixes, root words, and suffixes associated with Erythropoiesis/ Hematopoiesis.

6. differentiate between medullary hematopoiesis and extramedullary hematopoiesis.

7. list the abnormal conditions leading to extramedullary hematopoiesis.

8. identify the cell that gives rise to all cell lines and describe its characteristics.

9. identify the five general maturation characteristics of most cells.

10. describe, identify, and sketch the following erythropoietic cells with relationship to their cell size, nuclear, cytoplasm, and general characteristics:
    a. Rubriblast (pronormoblast)
    b. Prorubricyte (basophilic normoblast)
    c. Rubricyte (polychromatophilic normoblast)
    d. Metarubricyte (orthochromatic normoblast)
    e. Reticulocyte
    f. Erythrocyte

11. describe the stages of mitosis and its relationship to the cell cycle.

12. recall the normal life span of the erythrocyte.

13. differentiate between normal , megaloblastic, and microcytic erythropoiesis.

14. identify those conditions associated with megaloblastic and microcytic erythropoiesis.

15. define synchronism and asynchronism.

16. describe how the body controls or regulates normal erythropoiesis.

17. identify the primary production site of erythropoietin.

18. identify those factors, which will positively influence erythropoietin.

19. describe the changes that occur as a result of increased erythropoietin.

20. identify the primary hematologic test that is used to estimate the rate at which new RBCs are entering the peripheral blood from the bone marrow.

21. name the two stains used for reticulocyte counts.

22. explain why the reticulocyte stains are called supravital stains.

23. identify the blue material within a stained reticulocyte.

24. discuss briefly how automated Reticulocyte counts are measured.

25. calculate the reticulocyte count percentage when given the number of reticulocytes counted.

26. identify the normal adult and neonate reference ranges for reticulocyte counts.

27. identify clinical conditions that can cause the reticulocyte counts to increase and decrease.

28. identify sources of errors in the performance of a reticulocyte count.

29. calculate the absolute and corrected Reticulocyte count and discuss the significance of these calculations.

30. discuss the chemical and physical attributes of the biconcave shape of erythrocytes.

31. define the term poikilocytosis.

32. describe, identify and sketch the following variations in erythrocyte shape, identify their alternate names, and identify the cause and clinical significance of the variation:
    a. Echinocytes
    b. Acanthocyte
    c. Codocyte
    d. Drepanocyte
    e. Elliptocyte
    f. Schistocyte
    g. Dacryocyte
    h. Keratocyte
    i. Stomatocyte

33. define the term anisocytosis.

34. describe, identify, and sketch the following variations in erythrocyte size, correlate size differences with their MCV, and identify the cause and clinical significance of the variation:
    a. Normocytes
    b. Microcytes
    c. Spherocytes
    d. Macrocytes

35. explain the following terms used for variations in straining quality and give their clinical significance:
    a. Polychromasia
    b. Hypochromia
    c. Hyperchromia

36. describe, identify and sketch the following erythrocytic inclusions with relationship to what the inclusion is and identify the cause and clinical significance of each inclusion:
    a. Basophilic Stippling
    b. Howell-Jolly Bodies
    c. Cabot rings
    d. Siderocytic Granules
    e. Heinz Bodies
    f. Malaria
    g. Crystals

LECTURE 3: WHITE BLOOD CELL MATURATION

I. White Blood Cell Maturation and Development

A. Leukopoiesis

B. Granulocytic Series

C. Granulocytic Maturation
   1. Myeloblast
   2. Promyelocyte
   3. Myelocyte
   4. Metamyelocyte
   5. Neutrophilic Band
   6. Segmented Neutrophil

D. Neutrophilic Development Summary

E. Neutrophilic Shift
   1. Types
      a. Left
      b. Right
      c. Regenerative
      d. Degenerative

F. Function of Granulocytes
   1. Neutrophils
   2. Basophils
   3. Eosinophils

G. Leukemia vs Leukocytosis
   1. Definitions
      a. Leukemia
      b. Leukocytosis
      c. Physiological
      d. Pathological
   2. Granulocytic Leukocytosis
      a. Physiological Neutrophilia
      b. Pathological Neutrophilia
      c. Pathological Eosinophilia
      d. Pathological Basophilia

H. Leukopenia
   1. Definition
   2. Neutropenia

I. Lymphocytic Maturation
   1. Lymphoblast
   2. Prolymphocyte
   3 Mature Lymphocyte
      a. B-Lymphocyte
      b. T-Lymphocyte

J. Plasma Cell Maturation
    1. Plasmablast (Immunoblast)
    2. Proplasmacyte
    3. Plasma Cell

K. Lymphocyte Development
    1. Development
        a. Primary Lymphopoietic Organs
        b. Secondary Lymphatic Tissue
    2. T-Lymphocytes
    3. B-Lymphocytes
    4. Release
    5. Lymphocytosis
        a. Physiological
        b. Pathological

L. Monocyte Maturation
    1. Monoblast
    2. Promonocyte
    3. Mature Monocyte

M. Monocyte Development
    1. Development
    2. Life Span
    3. Function
    4. Monocytosis

N. Summary of White Cell Function

O. White Cell Count Reference Values

P. Differential
    1. Performing a Differential
    2. Clinical Significance
    3. Relative vs. Absolute Counts
    4. Reference Values for Differential
    5. Absolute Count Calculation
    6. Differential Components
        a. RBC Morphology
        b. WBC Morphology
        c. Platelet Estimate

Q. Staining
    1. Wrights Stain
    2. Troubleshooting Staining Problems

II. White Cell Morphology

A. Morphological Aberrations in WBC‘s

1. Toxic Granulation
2. Döhle Bodies
3. Hypersegmentation
4. Pelger-Huët Anomaly
5. Reactive Lymphocytes
6. Smudge Cell
7. Auer Rods
8. May-Hegglin Anomaly
9. Chédiak-Higashi Syndrome

B. Corrected WBC Count Calculation

C. Time Limit for WBC Counts

LECTURE 3: WHITE BLOOD CELL MATURATION

OBJECTIVES

At the end of this unit the student will be able to:

1. define the term leukopoiesis.

2. describe, identify, and sketch the following granulocytic cells with relationship to their cell size, nuclear, cytoplasmic, and general characteristics:
   a. Myeloblast
   b. Promyelocyte
   c. Myelocyte
   d. Metamyelocyte
   e. Neutrophilic Band
   f. Segmented Neutrophil
   g. Basophil
   h. Eosinophil

3. discuss the overall development (granulocytic pools), regulation, release, and life span of granulocytes.

4. explain the migrating effect of granulocytes from the circulatory system to extravascular tissue sites.

5. describe what is meant by a regenerative and degenerative "shift to the left" or "shift to the right" in circulating white blood cells.

6. describe the specific function of the following white blood cells.
   a. Neutrophils
   b. Basophils
   c. Eosinophils

7. identify the first, second, and third lines of defense in the immune system.

8. define the term chemotaxis and its relationship to neutrophils.

9. define the term diapedesis and its relationship to neutrophils

10. identify the major constituents of the granules in neutrophils, basophils, and eosinophils.

11. differentiate between leukemia and leukocytosis.

12. differentiate between physiologic neutrophilic leukocytosis and pathologic neutrophilic leukocytosis, and give examples of each.

13. define the following disorders and give examples of each:
   a. Eosinophilic Leukocytosis
   b. Basophilic Leukocytosis

14. define the term leukopenia.

15. define neutropenia and list several causes.

16. describe the type of granulation found in lymphocytes and monocytes.

17. describe, identify, and sketch the following lymphocytic cells with relationship to cell size, nucleus, cytoplasm, and general characteristics:
    a. Lymphoblast
    b. Prolymphocyte
    c. Mature lymphocyte (B- and T- lymphocytes)

18 . describe, identify, and sketch the following plasmacytic cells with relationship to cell size, nucleus, cytoplasm, and general characteristics:
    a. Plasmablast
    b. Proplasmacyte
    c. Mature plasmacyte (plasma cell)

19. identify the major site of maturation for normal lymphocytes

20. differentiate primary from secondary lymphoid tissue and the relationship with lymphocyte development.

21. explain the migrating effect of lymphocytes from the circulatory system to extravascular tissue.

22. differentiate between B- and T- lymphocytes with relationship to quantity in normal peripheral circulation and their roles in immunity.

23. differentiate between physiologic lymphocytosis and pathologic lymphocytosis and give examples of each.

24. define Plasmacytic Leukocytosis and give several examples

25. describe, identify, and sketch the following monocytic cells with relationship to cell size, nucleus , cytoplasm, and general characteristics:
    a. Monoblast
    b. Promonocyte
    c. Mature Monocyte

26. identify the major site of maturation for Monocytes.

27. explain the migrating effect of Monocytes from the circulatory system to extravascular tissue.

28. identify the name given to monocytes in the tissues.

29. define Monocytic Leukocytosis and give several examples.

30. describe the specific function of the following white blood cells.
    a. Lymphocytes
    b. Plasma Cells
    c. Monocytes

31. recall the normal reference values for a total white blood cell count.

32. recognize the quantitative relationship between white blood cells, red blood cells, and platelets.

33. describe a differential white blood cell count.

34. differentiate relative counts from absolute counts.

35. recall the normal reference values for relative differential counts.

36. calculate absolute differential leukocyte values from a given set of data.

37. calculate the normal absolute differential leukocyte range.

38. identify the variables that contribute to the thickness of making a blood smear by the wedge method.

39. describe the major components of Wright Stain and Wright's buffer and explain their function.

40. identify several problems with the Wright stain and how to resolve common problems.

41. describe the following morphologic aberrations found in white blood cells and give their clinical significance:
    a. Toxic granulation
    b. Döhle Bodies
    c. Hypersegmentation
    d. Pelger-Huët Anomaly
    e. Reactive (Atypical) Lymphocytes
    f. Smudge cell
    g. Auer Bodies (Rods)
    h. May-Hegglin Anomaly
    i. Chédiak-Higashi Syndrome

42. apply the formula used for correcting the total white blood cell count when nucleated red blood cells are seen in a differential.

43. identify the time limit for keeping EDTA blood for a white blood cell count.

LECTURE 4: PLATELET MATURATION

I. Platelet Maturation and Development

A. Definition

B. Function of Platelets:

C. Platelet Regulation and Storage

D. Thrombocytic Maturation
1. Megakaryoblast
2. Promegakaryocyte
3. Mature Megakaryocyte
4. Thrombocyte (Platelet)

E. Life Span

F. Platelet Structure
1. Peripheral Zone
2. Structural Zone
3. Organelle Zone

G. Platelet in Blood Coagulation
1. Adhesion
2. Aggregation
3. Viscous Metamorphosis
4. Consolidation
5. Stabilization

H. Reference Range

II. Clinical Significance

A. Thrombocytopenia
1. Decreased Production
2. Increased Destruction or Utilization
3. Distribution Disorders

B. Thrombocytosis

C. Qualitative Platelet Disorders
1. Aspirin Induced
2. Glanzmann s Disease
3. Von Willebrand Disease
4. Bernard-Soulier Disease

III. Specimens/Problems
A. Platelet Satellitism
B. Platelets In EDTA Blood
C. Platelets from Capillary Blood
D. Time Limit
E. Stain Characteristics

LECTURE 4: PLATELET MATURATION

OBJECTIVES

At the end of the unit the student will be able to:

1. define the term thrombocyte.
2. describe the general function of platelets.
3. identify the site(s) of platelet maturation and storage.
4. identify the hormone that controls platelet development and state where it is synthesized.
5. describe the normal thrombocytic development process.
6. define the term endomitosis.
7. describe, identify, and sketch the following thrombocytic cells with relationship to their cell size, nuclear, cytoplasm and general characteristics:
   a. Megakaryoblast
   b. Promegakaryocyte
   c. Mature megakaryocytic
   d. Thrombocyte (platelet)
8. recall the normal life-span of a platelet.
9. differentiate between the peripheral, structural, and organelle zone(s) of the platelet internal structure.
10. explain the function of the following chemical constituents found in blood platelets and where they are located within the platelet:
    a. Serotonin
    b. ADP
    c. Coagulation Factors
    d. Platelet Factor 4
    e. Platelet Derived Growth Factor (PDGF)
    f. Thrombosthenin (Actomyosin)
    g. Platelet Factor 3
11. describe platelet function in the blood coagulation process including adhesion, aggregation, metamorphosis, consolidation, and stabilization.
12. recall the normal reference values for a platelet count.
13. differentiate between thrombocytopenia and thrombocytosis and identify examples or causes of each.
14. identify the diagnostic tests for thrombocytopenia and thrombocytosis.

15. differentiate between the following platelet disorders:
    a. Aspirin induced
    b. Thrombasthenia (Glanzmann's disease)
    c. Von Willebrand's disease
    d. Bernard-Soulier

16. differentiate between anticoagulant blood (EDTA) and capillary blood in relationship to platelet size and distribution of a blood smear.

17. identify the time limit for keeping EDTA blood for a platelet count.

18. discuss Platelet Satellitism, in regards to what causes it and how it is eliminated.

19. describe the staining characteristics of the granulomere vs the hyalomere on the peripheral blood smear.

LECTURE 5: HEMOGLOBIN AND HEMATOCRIT

I. Hemoglobin
   A. Definition

   B. Function of Hemoglobin

   C. Site of Hemoglobin Formation

   D. Influencing Factors

   E. Hemoglobin Composition
      1. Heme
      2. Globin
      3. Diagram of Hemoglobin A1 Molecule
      4. Other Normal Hemoglobin Types

   F. Terminology
      1. Oxyhemoglobin
      2. Reduced Hemoglobin
      3. Ferrous Iron

   G. Reference Ranges

   H. Physiological Factors that Influence Hemoglobin

   I. Clinical Significance
      1. Decreased Values
      2. Increased Values

   J. Variant Hemoglobins
      1. Carboxyhemoglobin
      2. Methemoglobin
      3. Sulfhemoglobin

   K. Hemoglobinopathies
      1. Sickle Cell
      2. Hgb C
      3. Hgb H
      4. Hgb D
      5. Thalassemia

   L. Methods for Hemoglobin Quantitation
      1. Specific Gravity
      2. Cyanmethemoglobin

II. Hematocrit

   A. Definition

   B. Reference Ranges

   C. Relationship of Hematocrit with Hemoglobin

D. Layers of Separated Whole Blood

E. Clinical Significance of the Hematocrit
   1. Decreased Values
   2. Increased Values

F. Methods for Hematocrit Determination
   1. Manual Micro Hematocrit Method
   2. Automated

G. Sources of Error in Hematocrit Reading

LECTURE 5: HEMOGLOBIN AND HEMATOCRIT

OBJECTIVES

At the end of this unit the student will be able to:

1. describe the functions of hemoglobin.
2. identify the site of hemoglobin formation.
3. identify several influencing factors on hemoglobin production.
4. describe the formation of heme and globin and identify their composition, characteristics and percentages in the hemoglobin molecule.
5. identify the components of the hemoglobin A_1 molecule.
6. differentiate between the normal hemoglobins A_1, A_2 and F and identify their normal reference percentages.
7. differentiate between oxyhemoglobin and reduced hemoglobin.
8. explain the role iron plays in hemoglobin function.
9. recall the normal reference values in g/dL for hemoglobin in women, men and newborn infants.
10. identify certain factors that will influence hemoglobin reference values.
11. describe those conditions, which will decrease or increase hemoglobin values.
12. identify the three variations of normal hemoglobin.
13. differentiate between hemoglobin and methemoglobin.
14. define the term "hemoglobinopathy" and identify several examples.
15. define the term "thalassemia."
16. describe the principles, advantages and disadvantages of the following methods used to determine hemoglobin:
    a. Specific gravity.
    b. Colorimetric
        1) cyanmethemoglobin
17. define the term hematocrit.
18. recall the normal reference values for the hematocrit for men, women and newborn infants.
19. describe the relationship that exists between the hematocrit, hemoglobin and RBC readings on a patient.
20. identify the different layers of the venous hematocrit.

21. identify the composition of the buffy coat.

22. identify those conditions associated with decreasing and increasing hematocrit values.

23. describe the principles, reagents, equipment and calculations of the following methods used for hematocrit determination:
    a. Micro
        1) Adams
    b. Electronic or Optical
        1) Cell Counters

24. identify sources of error in the hematocrit reading.

LECTURE 6: ERYTHROCYTE SEDIMENTATION RATES

I. Erythrocyte Sedimentation Rates

A. Definition

B. Three Stages of Sedimentation of RBCs

C. Zeta Potential

D. General Principle of ESR

E. Reference Ranges

F. Factors that Increase ESR

G. Factors that Decrease ESR

H. Clinical Significance

I. Sources of Error

LECTURE 6: ERYTHROCYTE SEDIMENTATION RATES

OBJECTIVES

At the end of this period of instruction, the student should be able to:

1. Define the term Erythrocyte Sedimentation Rate (ESR)
2. Describe the three stages of sedimentation of RBCs in plasma.
3. Describe the relationship between zeta potential and sedimentation rates.
4. Describe the performance and interpretation of an Erythrocyte Sedimentation Rate (ESR) test.
5. State the normal ranges for male and female ESR for the Westergren Method (include units).
6. List physiologic causes of elevated ESR values.
7. List physiologic causes of decreased ESR values.
8. Describe the clinical significance of performing an ESR test.
9. Identify sources of error in the ESR test method.

CLSC 132 LECTURE OBJECTIVES AND OUTLINES

LECTURE 1: URINALYSIS

A. Urinalysis

1. Renal Structure
   a. Gross Anatomy
   b. General Kidney Function
   c. Microscopic Anatomy and Function
      1. Nephron
         a. Glomerulus
         b. Tubules
      2. Collecting System
   d. Urinary Statistics
      1) Filtrate
      2) Urine

2. Importance of Routine Urinalysis
   a. Extrinsic Disturbances
   b. Intrinsic Disturbances

3. Basic Routine Urinalysis
   a. Physical Properties
   b. Chemical Properties
   c. Microscopic Examination
   d. Standard Procedure

4. Collection of Urine
   a. Containers
   b. Collecting Procedures
   c. Specimen Types
   d. Specimen Integrity
   e. Criteria for Accepting a Urine Sample
   f. Preservatives

5. Appearance of Urine
   a. Color
      1. Normal
      2. Abnormal
   b. Odor
      1. Normal
      2. Abnormal
   c. Turbidity
      1. Normal
      2. Abnormal

6. Urine Volume
   a. Normal
   b. Abnormal
      1) Terms

7. Specific Gravity of Urine
   a. Definition
   b. Normal Values
   c. Clinical Significance
   d. Methods (Advantages & Disadvantages)
      1. Urinometer
      2. Refractometer
      3. pKa Change/Ionic Concentration
      4. Automated
      5. Osmolality

8. Urinary Nonprotein Nitrogen Compounds
   a. Types
      1. Urea
      2. Creatinine
      3. Uric Acid

9. Urine Chemistries
   a. Sensitivity
   b. Specificity

10. Urine pH
    a. Normal Values
    b. Clinical Significance
    c. Methods
       1) Chemical strip methods

11. Proteins in Urine
    a. Normal Values
    b. Clinical Significance
    c. Causes of Proteinuria
       1. Pre-renal
       2. Renal
       3. Post-renal
    d. Methods
       1. Chemistry Strip
       2. Semi-Quantitative Précipitation tests
       3. Quantitative UA Protein

12. Urine Glucose
    a. Renal Threshold
    b. Normal Values
    c. Clinical Significance
    d. Methods
       1. Chemistry Strip [Enzymatic Methods]
       2. Clinitest
    e. Other non-glucose sugars

13. Ketones in Urine
    a. Formation
    b. Types
    c. Clinical Significance
    d. Methods
        1. Chemistry Strip
        2. Acetest

14. Hemoglobin in Urine
    a. Clinical Significance (hemoglobinuria and hematuria)
    b. Method
        1) Chemistry Strip

15. Bilirubin in Urine
    a. Clinical Significance
    b. Methods
        1. Chemistry Strip
        2. Ictotest

16. Urobilinogen in Urine
    a. Normal Values
    b. Clinical Significance
    c. Methods
        1. Chemistry Strip
        2. Watson - Schwartz test

17. Detection of Bacteria in Urine
    a. Clinical Significance
    b. Methods
        1. Leukocytes
        2. Microscopic examination
        3. Chemistry Strip Method
        4. Microbiology Culture

18. Microscopic Examination of Urinary Sediment

    a. Clinical Significance
    b. Specimen Preparation
    c. Urinary Sediment Stain
        1. Composition of stain
    d. Normal Urinary Sediment
    e. Identification and Clinical Significance of Formed elements

        1. RBC
        2. WBC
        3. Epithelial Cells
            a. squamous
            b. transitional
            c. renal tubular
        4. Casts
            a. favorable conditions
            b. site of formation
            c. types
        5. Crystals
            a. Normal
            b. Abnormal
            c. Other
        6. Bacteria
        7. Yeast
        8. Parasites
        9. Spermatozoa
        10. Oval Fat Bodies
        11. Contaminants and Artifacts

LECTURE 1: URINALYSIS

OBJECTIVES

At the end of this unit, the student will be able to:

1. briefly describe the anatomy of the kidneys and the cardiac output of blood delivered to both kidneys.

2. identify the general functions of the kidney.

3. identify the following anatomical parts of the kidney and describe their functions:
   a. glomerulus
   b. Bowman's capsule
   c. afferent arteriole
   d. efferent arteriole
   e. proximal convoluted tubule
   f. loop of Henle
   g. distal convoluted tubule
   h. collecting tubules

4. describe the Renin-Angiotensin- Aldosterone System.

5. explain the general effect of Anti-diuretic hormone on the urinary system.

6. explain the general characteristics of glomerular filtrate and urine.

7. differentiate between extrinsic and intrinsic disturbances found in routine urinalysis and give examples of each.

8. differentiate between glomerulonephritis, pyelonephritis, cystitis, nephrotic syndrome, acute tubular necrosis, urinary obstruction, urethritis, and prostatitis.

9. identify the types of tests performed in the following basic categories of routine urinalysis:
   a. physical properties
   b. chemical analysis
   c. microscopic examination of urinary sediment
   d. standard procedure

10. recall those urine chemistry strip test methods that will give false negative test results when high levels of ASCORBIC ACID [Vitamin C] are present in the urine.

11. identify the types of containers used to collect urine and describe their purpose.

12. differentiate between a random urine sample and a “clean-voided” urine specimen.

13. identify three ways a “clean-voided” urine specimen can be collected.

14. identify the type of urine specimen preferred for routine urinalysis and describe the reasons this specimen is the preferred urine specimen.

15. describe the procedure for collecting a 2-hour postprandial specimen, fasting specimen, and 24-hour urine specimen.

16. explain the physical and chemical changes that occur if urine is not examined within one hour after collection and identify several possible criteria for rejecting urine specimens for routine analysis.

17. identify the best urine preservative.

18. explain why a refrigerated urine specimen should be allowed to warm room temperature before analysis.

19. describe the normal and abnormal colors of urine and identify the causes for each urine color.

20. explain how to handle a urine report when the urine's color interferes with the urine test strip results.

21. describe the odor of urine that has not been freshly collected, from patients with diabetes mellitus and amino acid disorders.

22. identify the normal cause of cloudy urine and describe the accepted process of removing amorphous crystals.

23. identify the pathogenic and nonpathogenic causes of cloudy or turbid urine.

24. define the terms: polyuria, oliguria, anuria, and dysuria and explain their clinical significance.

25. explain what is measured in a urine specific gravity.

26. identify the two major urine solutes, which contribute the most to urine’s specific gravity.

27. recall the normal values of a urine specific gravity from a random specimen, early morning specimen and a 24 hour specimen.

28. identify several pathological conditions, which may vary the specific gravity of urine.

29. define the terms: hyposthenuria, hypersthenuria, and isosthenuria and how they relate to specific gravity of urine.

30. describe the methods used to determine the specific gravity of urine and explain their advantages and disadvantages.

31. recall the variation in specific gravity using the urinometer and refractometer for every 1gm of glucose and 1 gm of protein in urine.

32. identify the measured solute differences between the refractometer and pKa methods.

33. explain the difference between osmolality and specific gravity measurements.

34. define osmole

35. identify the type and source of nonprotein nitrogenous compounds in urine.

36. differentiate between urine chemistry strip sensitivity and specificity.

37. explain the reason urine normally has an acidic pH.

38. recall the random and early morning urine pH normal values.

39. identify the name of amorphous material and nonpathogenic crystals associated with acid and alkaline urine.

40. describe the chemistry strip methods and identify the reagents used to determine urine pH.

41. identify causes of false alkaline and false acidic pH reactions in urine samples.

42. describe the clinical significance of protein in urine.

43. identify the type of protein usually excreted in kidney disease.

44. describe what pre-renal proteinuria is and identify several causes.

45. explain what Bence Jones Protein is and list its characteristics.

46. describe glomerulonephritis and identify several causes.

47. describe other causes of renal proteinuria other than glomerulonephritis.

48. explain what orthostatic proteinuria is and how it is diagnosed.

49. identify causes of post renal proteinuria.

50. describe the chemistry strip and SSA methods of protein determination including the reagents used.

51. identify the type of proteins measured in the chemistry strip and SSA methods of urine protein determinations.

52. explain what is meant by the term: “Protein- error of the Indicators”.

53. identify the causes of false positives when measuring protein in urine using chemistry strips and SSA methods.

54. identify the methods used to measure 24-hour urine protein.

55. explain the meaning of glucosuria and identify the glucose renal threshold value associated with glucosuria.

56. describe the clinical significance of measuring glucose in the urine.

57. describe the chemical methods, reactions, reagents, type of sugar being measured, reporting method, sensitivity, and causes of false negative and false positive reactions in the following methods:
    a. Chemistry Strip Methods
    b. CLINITEST Tablet

58. identify the other non-glucose substances that are measured by the CLINITEST Tablet method.

59. explain the purpose and clinical significance of performing the CLINITEST Tablet method on ALL pediatric urine specimens.

60. explain the process of ketone body formation.

61. identify the three types of ketone bodies.

62. describe the clinical significance of ketonuria.

63. describe the chemical methods, reactions, reagents, type of ketone body measured in the following methods:
    a. Chemistry Strip Methods
    b. Acetest Tablet

64. differentiate and describe the clinical significance of hemoglobinuria and hematuria.

65. describe the chemical method, reactions, and causes of false negative and false positive reactions in the urine test strip methods for blood.

66. explain how myoglobin can be differentiated from hemoglobin.

67. explain the general metabolism of bilirubin.

68 describe the clinical significance of bilirubin in the urine.

69. describe the chemical method, reactions, sensitivity, and causes of false positive and negative reactions in the following tests for urine bilirubin:
    a. Chemistry Strips
    b. Ictotest Tablet

70. recall the normal metabolism of urobilinogen.

71. recall the average normal values of urobilinogen.

72. describe the clinical significance of urobilinogen in urine.

73. describe the chemical method, reactions, and causes of false positive and negative reactions of the following tests for urobilinogen or porphobilinogen:
    a. Chemistry Strip Methods
    b. Watson - Schwartz Test

74. describe the clinical significance of bacteriuria.

75. identify the amount of bacteria per mL of urine needed before bacteriuria is considered significant.

76. describe the chemistry strip methods, reactions, and causes of false positive and negative reactions for leukocytes in urine.

77. explain the correlation between leukocytes in urine and bacteriuria.

78. describe the following methods used for detecting bacteria in urine including reactions, methods, and causes of false positive and false negative reactions:
    a. microscopic examination
    b. chemical strip method for urine nitrite
    c. urine culture

79. identify the incubation time needed for bacteria to convert nitrates to nitrites.

80. compare the microscopic examination of urinary sediment with respect to the chemistry test results on that urine.

81. describe specimen preparation steps for performing microscopic urinalysis.

82. identify the name and composition of the stain used for staining urinary sediment for microscopic examination.

83. describe the composition of normal urinary sediment.

84. identify the following formed elements found in urine and describe their clinical significance:

    a. RBC
    b. WBC
    c. Epithelial Cells (squamous, transitional, renal tubular)
    d. Casts
    e. Normal and Abnormal Crystals
    f. Bacteria
    g. Yeast
    h. Parasites
    i. Oval Fat Bodies / Fat
    j. Contaminants and Artifacts

85. identify the four conditions that when present favor the formation of casts in the kidney tubules.

86. identify the primary site of cast formation.

87. describe the clinical significance of the following casts:

hyaline	waxy
WBC	broad
RBC	epithelial
coarse granular	cylindroids
fine granular	fatty

88. explain the degradation processes of a cellular cast.

89. explain the process of differentiating between cholesterol and triglyceride oval fat bodies.

90. when given physical, chemical, and microscopic results, evaluate the urinalysis results and correlate with clinical conditions such as glomerulonephritis, pyelonephritis, lower urinary tract infection, diabetes mellitus, renal failure, nephrotic syndrome, metabolic disease, urinary tract trauma, etc.

LECTURE 2: CEREBROSPINAL FLUID

I. Cerebrospinal Fluid

A. Anatomy and Physiology
B. Specimen Collection, Transport, and Storage
   1. Diagnostic Value
   2. Collection
   3. Volume
   4. Distribution of Collection Tubes
   5. Transportation and Storage

C. Constituents of Cerebrospinal Fluid
   1. Cells
      a. White Blood Cells
         1. Reference Ranges
         2. Clinical Significance
      b. Red Blood Cells
         1. Reference Ranges
         2. Clinical Significance
         3. Distinguishing Traumatic Tap from Subarachnoid Hemorrhage
   2. Glucose
         1. Reference Range
         2. Clinical Significance
   3. Protein
         1. Reference Range
         2. Clinical Significance
   4. Lactate
         1. Reference Range
         2. Clinical Significance

D. Meningitis
   1. Definition
   2. Causes
   3. Differentiating Bacterial vs. Viral Meningitis

E. Other Central Nervous System Disorders
   1. Multiple Sclerosis
   2. Neurosyphilis

F. Cell Counting Calculations

LECTURE 2: CEREBROSPINAL FLUID

OBJECTIVES

At the end of this unit, the student will be able to:

1. describe the general anatomy and physiology of the Central Nervous System, and the process by which cerebrospinal fluid is formed.

2. describe the purpose of cerebrospinal fluid.

3. identify the most important indication for collecting cerebrospinal fluid.

4. state the proper procedure used for collection of cerebrospinal fluid and filling the specimen tubes, identifying the correct specimen tube for each department of the laboratory.

5. describe the proper transport and storage conditions for cerebrospinal fluid.

6. identify the cellular elements, which are normally found in cerebrospinal fluid, and identify their normal reference ranges.

7. identify the chemical analytes, which are normally found in cerebrospinal fluid, and their normal concentrations.

8. distinguish between a traumatic tap and a subarachnoid hemorrhage.

9. discuss the clinical significance of abnormal findings in the cell count and chemistry data obtained in analysis of cerebrospinal fluid, suggesting patient conditions which would result in data given.

10. define the pathological condition of meningitis, and differentiate bacterial from viral infections, based on cerebrospinal fluid laboratory findings.

11. describe the condition of multiple sclerosis, and indicate expected changes in cerebrospinal fluid findings for patients with this disease.

12. define neurosyphilis, list symptoms seen in this condition, and predict its effect on cerebrospinal fluid findings.

13. describe the procedure for performing CSF cell counts, and correctly perform calculations to obtain WBC and RBC counts on cerebrospinal fluid.

LECTURE 3: SYNOVIAL FLUID

I. Synovial Fluid

A. Specimen Collection, Transport, and Storage
1. Collection Sites
2. Collection Process
3. Collection Tubes
4. Transportation
5. Analysis

B. Normal Appearance
1. Appearance
2. Viscosity

C. Normal Microscopic Elements

D. Normal Chemical Analytes

E. Differentiation of Arthritis
1. Noninflammatory
2. Inflammatory
3. Infectious
4. Hemorrhagic
5. Crystal-Induced

LECTURE 3: SYNOVIAL FLUID

OBJECTIVES

At the end of this unit, the student will be able to:

1. define synovial fluid, and describe its formation within joint cavities.

2. describe the collection process for synovial fluid, and state the transport and storage conditions necessary for its preservation.

3. describe the normal appearance of synovial fluid, and state the normal microscopic elements and chemical analytes that can be expected to be part of a synovial fluid specimen.

4. describe the changes in appearance, chemical analytes, and/or microscopic elements for the following types of arthritis:
   a. noninflammatory
   b. inflammatory
   c. infectious (septic)
   d. hemorrhagic
   e. crystal-induced

LECTURE 4: SEMEN ANALYSIS

I. Semen Analysis

A. Anatomy and Physiology
B. Specimen Collection, Transport, and Storage
C. Normal Cellular and Chemical Constituents
    1. Cellular
    2. Chemical
D. Complete Semen Analysis
    1. Volume
    2. Viscosity
    3. pH
    4. Sperm Count
    5. Motility
    6. Viability
    7. Morphology

LECTURE 4: SEMEN ANALYSIS

OBJECTIVES

At the end of this unit, the student will be able to:

1. describe the anatomy and physiology of the male reproductive system with regards to the formation of semen.

2. explain the specimen collection, and transport and storage requirements for preservation of semen samples.

3. identify the time of abstinence prior to semen collection.

4. describe the normal cellular and chemical constituents found in semen.

5. define the term “liquefaction” and identify the normal time for this process to occur in seminal fluid.

6. describe the normal volume, viscosity, pH, sperm count, motility, and viability procedures and identify their normal reference values.

7. calculate a sperm count and report the number in the correct units.

8. describe the normal cellular morphology of sperm cells, and describe some abnormal forms sometimes observed in semen.

LECTURE 5: EFFUSIONS

I. Effusions

A. Definition of Effusions
1. Three body Cavities
2. Membranes Involved
3. Primary Function of Fluids
4. Normal Fluid
5. Increased accumulation of Fluid
6. Aspiration of Fluid
7. Terminology
8. Collection Tubes

B. Transudates

C. Exudates

D. Differentiation between Transudates and Exudates.

E. Differentiation between Chylous Effusion and Pseudochylous Effusion

LECTURE 5: EFFUSIONS

OBJECTIVES

At the end of this unit, the student will be able to:

1. identify the location of the pleura cavity, pericardial cavity, and the peritoneal cavity.
2. differentiate between the parietal and visceral membranes and describe their function.
3. describe the process of fluid formation in the three body cavities.
4. identify the term used to describe the abnormal accumulation of fluid in the three body cavities.
5. identify the terms associated with the aspiration of fluid from the three body cavities.
6. identify the collection tubes effusion fluid is placed into and explain the departments these tubes are sent for analysis.
7. define the terms “transudate” and “exudate” and describe how these effusions are formed.
8. describe the “normal” appearance of serous fluid taken from the three body cavities.
9. differentiate between transudates and exudates based on causes of accumulation, protein content, cellular content, LD level, calculated ratios, and appearance.
10. explain the clinical significance of the following laboratory data in relationship to transudates and exudates:
    a. appearance
    b. cell counts
    c. total protein
    d. fluid to serum ratio for total protein
    e. lactic dehydrogenase
    f. fluid to serum ratio for LD
    g. glucose
11. differentiate between Chylous and Pseudochylous effusions based upon appearance, triglyceride content, and cause.

LECTURE 6: AMNIOTIC FLUID

I. Amniotic Fluid

A. Specimen Collection, Transport, and Storage
B. Normal Appearance
C. Amniocentesis
D. Clinical Significance
    1. Creatinine
    2. Bilirubin
    3. Alpha-1-Fetoprotein
    4. L/S Ratio
    5. Phosphatidylglycerol

II. Fetal Fibronectins

LECTURE 6: AMNIOTIC FLUID

OBJECTIVES

At the end of this unit, the student will be able to:

1. describe the location, production and function of amniotic fluid.

2. describe the collection procedure, and transport and storage requirements for the preservation of amniotic fluid.

3. describe the normal appearance of amniotic fluid, and identify the test that should be performed if significant blood is found in amniotic fluid to determine if the blood is from the fetus.

4. define the process of amniocentesis, and list some potential complications of this procedure.

5. describe the clinical significance of changes in the following analytes in amniotic fluid:
   a. creatinine
   b. bilirubin
   c. alpha-1 fetoprotein
   d. L/S ratio and Phosphatidylglycerol

6. describe the purpose and clinical significance of fetal fibronectins.