**MCB 2010C MICROBIOLOGY**

 **CRN 16046**

 **Fall 2018 Course Syllabus**

**INSTRUCTOR INFORMATION**

|  |  |
| --- | --- |
| NAME: | Professor Mahreen Ahmed |
| OFFICE | **AHS 231** |
| PHONE: | Office: 407-5821407 |
|  |  |
| E-MAIL: | mahmed20@valenciacollege.edu |
|  |  |
| OFFICE HOURS:  | Can be reached by ATLAS Email. |
|  |  |
|  |  |

**COURSE INFORMATION**

|  |  |
| --- | --- |
| CONTACT HRS/WK: | 6 (3 lecture and 3 laboratory) |
| TERMS OFFERED:  | Every term (as needed) |
| MEETING TIMES: CREDIT HOURS: | LECTURE: Tuesday 7:00am- 9:45am AHS rm. 210LAB: Thursday 7:00am- 9:45am AHS rm. 3204 |
| LECTURE Material: | Class PowerPoint note slides by Mahreen Ahmed (from Atlas Faculty FrontDoor) – students will print these out from home as assigned*Required: Microbiology:Cowan, Text 5th Edition (W/Connect/Learnsmart Access card)* |
| LAB BOOK:  | Microbiology Laboratory Theory and Application (Brief Edition) Leboffe And Pierce is REQUIRED |
|  |  |
|  |  |

This course outline and syllabus are subject to change as needed. Changes will be announced in class when necessary.

COURSE DESCRIPTION: A survey of microbial organisms with an emphasis on bacteria, their morphology, physiology, growth, control and genetic mechanisms. Pathogenic microbes and their metabolism are discussed as are host defense mechanisms utilized to prevent infectious diseases.

SPECIFIC COURSE GOALS: To prepare nursing and other allied health majors to function safely and knowledgably in environments where pathogenic microbes are present causing human disease or where microbes are the subject of academic, medical or scientific inquiry.

ADDITIONAL INFORMATION:

1. Microbiology is traditionally a course at the sophomore level; regular attendance and full participation, in lecture and the laboratory, is expected and is essential for success in the course. Grade expectations can only be fulfilled with full participation, complete assignments and sufficient time. Attendance will be taken during each lecture and lab.

2. The **lab manual, a permanent marking pen, a lab coat (or suitable substitute), and proper footwear are required for the lab**. A set of colored pencils and a medical dictionary have also aided students in the past, but are not required.

3. It is essential to learn correct lab techniques for the safety of all colleagues and personnel. Read about student lab safety at the beginning of your lab manual before the first lab. **You must KNOW what to do when microbes are spilled in the lab!!**

4. Students with disabilities who qualify for academic accommodations must provide a letter from the Office of Students with Disabilities (OSD) and discuss specific needs with the professor, preferably during the first week of classes. The Office of Students with Disabilities determines accommodations based on appropriate documentation of disabilities (West campus SSB 102, ext. 1523).

5. Students are expected to comply with all VCC policies regarding academic honesty and other requirements presented in the college catalogue. No VCC property may be removed from the lab.

 Any student cheating on a test or quiz will receive a zero (0%) for the test or quiz in question.

6. College policy prohibits children from attending lectures or labs; please, do not violate this policy.

7. Proper classroom etiquette is required for you to attend this class; please do not talk while the professor is lecturing. Repeated warnings, for improper classroom behavior, followed by the calling of security, will be sufficient grounds for being dropped from the course without a refund.

8. Beepers or cell phones which emit audible tones should be turned off or to vibrate during periods when lectures are given in the lecture or the lab. Please, do not use your phone for text messaging during lectures; text messaging and phone calls should only occur outside the lecture room.

10. The grading system has a total of 1,500 points. A grade summary sheet (found in this packet) is provided to keep track of your grades. You are responsible for knowing your grades and your standing in the class. If you are in doubt about a grade you should contact the professor. Midterm (pre-withdrawal deadline) and pre-final exam averages will be computed by the professor for each student to assess the student’s progress in the class.

9. The **grading scale** for the course is:

(90-100% = A; 80-89% = B; 70-79% = C; 60-69% = D; less than 60% = F)

**4 Lecture Exams- one must be dropped (100 points each)……….………………..300 points**

**Chemistry Homework Assignment……………………………………………...….70 points**

**4 Power Point HW Assignments (50 points each)………....……..………………...200 points**

**5 Lab Quizzes- one must be dropped (25 points each)……….....…...…………….100 points**

**2 Lab Practical Exams (200 points each)…………………………………………..400 points**

**Lab Technique (see #15 below)………………………………………….…………..30 points**

**MMWR and DNA Homework Assignments (40 points each)…………………..…80 points**

**Mandatory Final Lecture Exam (cumulative)……………………………..............200 points**

**Connect Learnsmart online HW Assignments……...……………………………...120 points**

 **Total points…………………………………………………………………………..1500 points**

11. **Lecture tests 1-4 CANNOT be made up**. The lowest lecture test grade, from lecture tests 1-4, will be dropped.

12. There will be 1 chemistry homework, 4 power point homework assignments and 5 laboratory quizzes. The homework assignments can be handed in personally, or submitted using Canvas. The lowest lab quiz grade will be dropped. One of your lab quiz grades can be replaced with 25 points if you submit proof that you donated blood to an approved blood collection center, by the time you take the final lab practical exam. There is no other “extra-credit.” Quizzes will occur during the beginning of the period and take a maximum of 20 minutes. There are no quiz or homework make-up assignments; if you are late for a quiz, you miss it.

13. The 4 power point homework assignments (to be announced in class) are due at the beginning of the class period on their due date. Once a class has met, a five point deduction/day, including the due date, is made for all late assignments.

14. Your attention to detail in the microbiology laboratory is required. There are no lab make-ups. Lab practical exams can only be made up in the case of an emergency at the discretion of Professor Ahmed.

15. Some activities involve dangerous microbes and/or expensive equipment. Proper care and cleaning of the microscope is critical. Errors in lab disinfection, proper attire or microscope care will result in the deduction of points from your lab technique grade. You will lose **lab technique points** for each of the following infractions:

|  |  |
| --- | --- |
| No lab jacket (or suitable substitute), lack of gloves, wearing inappropriate footwear  | 1 point/each infraction |
| Improper microscope care and cleaning  | 1 point/ infraction |
| Lack of lab attendance | 3 points/ lab missed after 1 free lab absence |
| Improper disinfection, aseptic technique, |  |
|  incubation or inoculation | 1 point/ infraction |
| Eating or drinking in the labNot informing professor of a microbial spill | 5 points/ infraction5 points/ infraction |

In science and in medicine, accuracy is mandatory. There are often no extra materials in the lab, so please ask before taking extra materials, to see if there are enough.

16. During each lecture and laboratory period, an attendance **roster will be provided for you to sign**; if you are late to lecture or lab, it is your responsibility to add your signature to the roster. Missing signatures are viewed as absences; leaving early from a lab will be counted as a lab absence. More than one absence has proven, in the past, to be a sign that your grade will be substantially less than you may have hoped for and will result in the loss of lab technique points. Signing in for another student will result in the student who forges the sign-in being referred to the Academic Dean of Students on charges of dishonesty and five (5) lab technique points will be deducted from the forger’s grade.

17. An MMWR homework assignment and DNA HW are due at the beginning of class period designated by the due date. Early assignments are encouraged; if late, this assignment will incur an immediate 10 points deduction for being late and two (2) points more will be deducted for each additional day that the assignment is late. The homework will not be accepted after you have taken the final lecture exam.

18. The **final lecture exam is cumulative and mandatory**. The college sets the final lecture exam date. The final lecture exam cannot be dropped or used as a substitute for any other test. Missing the final exam will result in a mandatory F grade. After taking the make-up final exam, a letter grade (A, B, C, D, or F) will be then assigned.

19. Under no circumstances will your test scores, total points or final grades be discussed on the telephone or over e-mail. FERPA rights to privacy prevent the divulging of scores or related materials by these means. Scores will only be given face-to-face with each student or by accessing your Atlas account.

20. All tests are the material of Professor Ahmed. Any test that is copied or that leaves the room with a student will be entered in the grade book as a zero. Hats or caps, cell phones and any other electronic device, food and beverages are NOT allowed when taking a test or a quiz.

21. One goal of the course is to integrate the four Valencia Student Core Competencies (Think, Value, Communicate, and Act) into the microbiology curriculum.

THINK = Think clearly, critically, creatively; analyze, synthesize, integrate and evaluate in many domains of human inquiry.

1. you will analyze data and scientific principles as they pertain to microbiology
2. you will employ facts, formulas and procedures in lecture and in lab groups
3. you will discover and understand how microbiology is important in various fields and in disciplines other than in medicine
4. you will be able to draw well supported conclusions about the importance of microbiology in your daily life and in your career
5. you will be able to revise conclusions in light of new observations and interpretations

VALUE = Make reasoned judgments and responsible commitments.

1. you will be able to compare personal, ethical, and scientific values in the fields of genetics, chemotherapy, environmental science and patient care
2. you will value the time commitment needed to succeed in the allied health programs

COMMUNICATE = Communicate with different audiences using varied means.

1. you will be able to practice written communication skills
2. you will be able to verbally communicate to fellow students and teachers using professional, scientific language during lectures and especially during labs

ACT = Act purposefully, effectively and responsibly.

1. you will be able to manage your time and activities to achieve your academic goals
2. you will meet deadlines
3. you will apply the knowledge you learn to your career goals

22. Some **study and classroom management tips,** in this course, which can be of assistance:

- **don’t be tardy to class and do attend class daily**; students who follow this rule, won’t miss important information and the introduction to each lecture which is important to understand the entire lecture’s purpose

- **prepare for class and allow plenty of time (1-2 hours) to study every day**

- **REWRITE YOUR NOTES** soon after the lecture;

- **make a lab journal** when you get home to review everything you did , used, saw and explain why you saw what you saw in the lab to refresh your memory when studying for the lab practical exams; make charts and tables to organize your thoughts about the different media

- use **flash cards** with questions you make up from the lecture and lab with answers on the back

- use **mnemonic devises and other games** to remember concepts; go to Google images and YouTube for additional pictures and videos to clarify concepts

- **make lists of confusing topics** from your studying and **ask questions**.

- when you have studied sufficiently, **JOIN A STUDY GROUP** and predict what questions the professor could ask on the test

- **get the telephone number of one or more buddies** in case you are absent from a class

REMEMBER LEARNING IS AN ACTION VERB!! Most students need to do more than just sit through lectures and reread their notes. **Spend 1-2 hour blocks of time EVERY DAY** actively writing or discussing concepts to make them a part of your memory. Use the words you learn often, they will sink in better☺.

23. **All lecture materials can be downloaded from my Faculty FrontDoor page** which can be found by following these steps:

 - enter Valencia’s homepage at www.valenciacollege.edu

 - under Current Students, click on Faculty Web Sites

 - on the Faculty Web Site page look for and click on Faculty FrontDoor

 - on the Faculty FrontDoor page click on my name, Mahreen Ahmed, then, on my FrontDoor page, click on Course Materials and you will see the materials for the class that you can print as the professor assigns them.

24. Valencia College is interested in making sure all our students have a rewarding and successful college experience.  To that purpose, Valencia students can get immediate help that may assist them with psychological issues dealing with stress, anxiety, depression, adjustment difficulties, substance abuse, time management as well as relationship problems dealing with school, home or work.  Students have 24 hour unlimited access to the BayCare Behavioral Health’s confidential student assistance program phone counseling services by calling **(800) 878-5470**. Three free confidential face-to-face counseling sessions are also available to students.

25. The **deadline for Drop/Refund is September 4, 2018**. Per Valencia Policy 4-07 (Academic Progress, Course Attendance and Grades, and Withdrawals) a student who withdraws from class before the **withdrawal deadline of November 9, 2018** will receive a grade of “W.” A student is not permitted to withdraw from this class after the withdrawal deadline; if you remain in the class after the withdrawal deadline, you can only receive a grade of A, B, C, D, F or I. An I grade will only be assigned under extraordinary circumstances that occur near the end of the semester. If you receive an I, the work missed must be made up during the following semester, at which time you will get an A, B,C,D or F. Failure to make up the work during the following semester will result in you getting a grade of F in the course. The professor will not withdraw any student for any reason; it is the responsibility of the student to withdraw themselves before the withdrawal deadline and to be aware of the date of the withdrawal deadline. Any student who withdraws from this class during a third or subsequent attempt in this course will be assigned a grade of “F.”

 For a complete policy and procedure overview on Valencia Policy 4-07 please got to:

 <http://valenciacc.edu/generalcounsel/policydetail.cfm?RecordID=75>

26. Your continued participation in this course after the drop-add deadline period constitutes an agreement with and an acceptance of the conditions presented in this syllabus.

MAJOR LEARNING OUTCOMES EXPECTED FROM STUDENTS WHO TAKE THIS COURSE

1. Students will be able to identify the major milestones in the history of microbiology

2. Students will be able to describe how macromolecules contribute to the functions necessary for life.

3. Students will be able to assign microorganisms to the appropriate domain and kingdom.

4. Students will be able to differentiate between prokaryotic and eukaryotic organisms and explain the function of each structure in both cell types.

5. Students will gain an understanding of viruses by explaining viral structure, multiplication and control.

6. Students will be able to explain basic microbial metabolism and summarize what is needed for the growth of microorganisms.

7. Students will be able to describe all the chemical and physical means available to control microbes and to identify those that provide sterility.

8. Students will be able to identify the mechanism of action of commonly used antibiotics and the concerns associated with antibiotic misuse.

9. Students will model their knowledge of molecular genetics and recognize the importance of basic genetic engineering.

10. Students will be able to demonstrate the appropriate use of epidemiological terminology in the context of public health.

11. Students will be able to identify the mechanisms of pathogenicity and distinguish different levels of immunity operating in the body.

12. Students will be able to identify the causes of major human infectious disease and relate that information to the appropriate organ system.

13. Students will be able to demonstrate a working knowledge of aseptic technique.

14. Students will demonstrate an understanding of microscopy.

15. Students will be able to integrate their lab knowledge to identify unknown microbes and determine how appropriate antibiotics are chosen for given bacterial infections.

|  |  |  |
| --- | --- | --- |
| **WEEK (Dates)** | **Microbiology Fall 2018 Lecture Topics** | **Tests and Homework Due Dates** |
|  1 8/28 | Introduction & Student Success, Discuss Chemistry HW Assignment What is Microbiology? Ch.1 |  |
|  2 9/4 | The Chemistry of Living Things (inorganic & organic chemistry HW review), The History of Microbiology Ch. 1, Ch. 2, Ch. 3 | Chemistry HW **due 9/4** (There will be no late Chemistry HW Assignments accepted; late = 0 points |
|  3 9/11 | Epidemiology Ch. 13Prokaryotic Cell Anatomy Ch. 4  | Power Point HW #1 **due 9/11**Lab Quiz #1 **9/13** |
|  4 9/18 | Prokaryotic/Eukaryotic Cell Comparisons Ch. 5 | **LECTURE TEST #1** (lecture packet #1) **9/18** |
|  5 9/25 | Eukaryotic MicrobesArthropod-borne DiseasesViruses Ch. 5, Ch. 6 | Lab Quiz #2 **(Announced in Class)** |
|  6 10/9 | Microbial Growth and Nutrition Ch. 7 | Power Point HW#2 **due 10/9**Lab Quiz #3 **(Announced in Class)** |
|  7 10/16  | Microbial MetabolismCh. 8 | **LECTURE TEST #2 (lecture packet #2)** **10/16** Lab Quiz #3 **(Announced in Class)****LAB PRACTICAL MIDTERM EXAM** **10/18**  |
|  8 10/23 | Continued.. |  |
|    9 10/30 | Chemical/Physical Control of Microbial Growth, food poisioningAntibiotics Ch. 11, 12 |  |
|   10 11/6 11 11/13 |  Microbial GeneticsCh. 9 | ***Withdrawal deadline- Nov. 9, 2018***Power Point HW#3 **due 11/13**Lab Quiz #4 **(Announced in Class)** |
|  12 11/20 | Genetic Engineering, Environmental Microbiology, Water-borne Diseases Ch.10, Ch. 24, Ch.25 | **LECTURE TEST #3** (lecture packet #3)**11/20****DNA HW due 11/20** |
|  13 11/27   | Continued…. | Lab Quiz #5 **(Announced in Class)**Power Point HW **due 11/27** |
|  4 12/ 4  | How Microbes cause Disease, Immunology (1st line of defense) (cont.), Pathogens of Various Organ Systems Ch. 14, 15 |  **MMWR ASSIGNMENT due12/4** **LECTURE TEST #4** (packet 4) **12/4** **LAB PRACTICAL FINAL EXAM 12/6**  |
|  15 4/20 |  Immunology (continued) |  |
|   16 4/27 | FINAL EXAM WEEK | **Final Lecture Exam Dec 11, 2018**  **7:00 am- 9:30 am** |

 **GRADE SUMMARY SHEET**

 **(Total points = 1500)**

|  |  |
| --- | --- |
| **Chemistry Homework \*\*\* (70 points)** |  |
| **Power Point HW #1 \*\*\* (50 points)** |  |
| **Lab Quiz #1 (25 points)** |  |
| **Lecture Test #1 \*\* (100 points)** |  |
| **Power Point HW #2 \*\*\* (50 points)** |  |
| **Lab Quiz #2 (25 points)** |  |
| **Lecture Test #2 \*\* (100 points)** |  |
| **Power Point HW #3 \*\*\* (50 points)** |  |
| **Lab Practical Midterm Exam (200 points)** |  |
| **Lab Quiz #3 (25 points)** |  |
| **Lecture Test #3 \*\* (100 points)** |  |
| **Lab Quiz #4 (25 points)** |  |
| **DNA HW \*\*\* (40 points)** |  |
| **Power Point HW #4\*\*\* (50 points)** |  |
| **Lecture Test #4 \*\* (100 points)** |  |
| **Lab Quiz #5 \* (25 points)** |  |
| **Lab Practical Final Exam (200 points)**  |  |
| **MMWR Assignment \*\*\* (40 points)** |  |
| **Lab Technique (30 points)** |  |
|  **Connect Learnsmart Online HW (120 points)****FINAL LECTURE EXAM (200 points)****(Cumulative)** |  |

**(\* = The lowest lab quiz WILL be dropped at the end of the course and cannot be used as a bonus.)**

**(\*\* = The lowest grade of lecture tests 1-4 WILL be dropped at the end of the course to calculate your grade, the dropped test cannot be used as a bonus; there are no make-up quizzes or lecture exams)**

**(\*\*\* = For homework assignments, if you are absent for a deadline, have someone else bring in your answers to class. E-mail @** **mahmed20@valenciacollege.edu****. There is a 5 point deduction/day for all late homework assignments.**

Early submission of Homework is encouraged.

MICROBIOLOGY (MCB 2010C) LABORATORY EXERCISES

Valencia College – *Fall 2018*

Week 1. **Lab Introduction** (Aug 27th – Sept 1st)

 - Safety and laboratory Guidelines: students read pp. 1-6

 - “Scavenger hunt” (introduce students to location of lab’s safety equipment)

 - Exercise 1-1 Glo-Germ™ Hand Wash Education System (optional)

 - Exercise 2-1 Ubiquity of Microbes

 - Exercise 3-1 Introduction to the Light Microscope

 - learn parts, use, care and storage of the microscope; crossed thread and letter “e” prepared slides,

 - Exercise 3-3 Examination of Eukaryotic Microbes (begin observing prepared slides)

*There are no VC classes on Monday, Sept 3rd due to Labor Day holiday!*

Week 2. **Culturing Bacteria and Using the Microscope** (Sept 4th – 10th)

- Analysis of last week’s experiment

 - Students read Exercise 1-2 about Nutrient Agar and Nutrient Broth Preparation,

 page 19, and pp. 59-66 about Colony Morphology

 - Exercise 1-4 Common Aseptic Transfers and Inoculation Methods

 - Exercise 1-5 Streak Plate Methods of Isolation

 - Exercise 2-11 Steam Sterilization (“field trip demo” to see and explain the principles of an autoclave) (optional)

 - Exercise 3-1 Introduction to the Light Microscope (cont.)

 - Exercise 3-3 Examination of Eukaryotic Microbes (finish observing prepared slides)

Week 3. **Staining I** (Sept 11th – 17th)

 - Analysis of last week’s experiments

 Students read pp. 69 and 73 about Growth Patterns on Slants and Broth

 Students read pp. 153-158

 - Exercise 3-4 Simple Stains

 - Exercise 3-5 Negative stains

 (Optional- assess each student’s ability to properly clean the microscope)

 - Exercise 3-10 Wet Mount Preparations – Live protist samples or pond water samples from Lake Pamela (Students read page 143)

Week 4. **Staining II** (Sept 18th – 24th)

 - Exercise 3-6 Gram Stain (optional assessment of student ability to observe stained bacteria under the oil immersion lens)

 - Exercise 3-7 Acid-Fast Stain (prepared slides for observation)

 - Exercise 3-9 Endospore Stain (prepared slides for observation)

 **Selective and Differential Media** - Students read pp. 77, 207 and 237

 - Exercise 4-1 Phenylethyl Alcohol Agar

 - Exercise 4-2 Columbia CNA with 5% Sheep Blood Agar

 - Exercise 4-3 Mannitol Salt Agar

 - Exercise 4-4 MacConkey Agar

 - Exercise 4-5 Eosin Methylene Blue Agar

 - Exercise 4-6 Hektoen Enteric Agar

Week 5. **Physical Growth Factors for Bacterial Growth** (Sept 25th – Oct 1st)

 - Analysis of last week’s experiments

 Students read pp 95

 - Exercise 2-6 Fluid Thioglycollate Medium

 - Exercise 2-8 The Effect of Temperature on Microbial Growth

 **Bacterial Nutrition**

 **-** Exercise 5-10 Starch Hydrolysis

 **-** Exercise 5-11 DNA Hydrolysis

 - Exercise 5-12 Lipid Hydrolysis

 - Exercise 5-13 Casein Hydrolysis

 - Exercise 5-16 Bile Esculin Test

Week 6. **Introduction to Biochemical Test Media** (Oct 2nd – Oct 8th)

 - Analysis of week 5 experiments

- Exercise 5-4 Catalase Test

 - Exercise 5-5 Oxidase

 - Exercise 5-6 Nitrate Reduction

 - Exercise 5-9 Phenylalanine deaminase

 - Exercise 5-19 Triple Sugar Iron Agar/Kligler Iron Agar

 - Exercise 5-23 Coagulase and Clumping Factor Tests

*There will be NO scheduled labs on* ***Oct 9th – 13th*** *as this will allow all the labs to be on the same schedule on the following week. Instructors may use this time to lecture, if so desired.*

Week 7. MIDTERM LAB PRACTICAL EXAM WEEK (Oct 15th – 20th)

 - Materials come from laboratory experiments performed during weeks 1-5

**-** Analysis of week 6 experiments (You also have the option of doing this during week 8, before the C&S inoculation labs)

Week 8. **Culture and Sensitivity (C&S)** (Oct 22nd – 27th)

 Students read page 573-574

 - Exercise 5-2 Phenol Red Fermentation Broth

 - Exercise 5-3 Methyl Red and Voges-Proskauer Tests

 - Exercise 5-7 Citrate Utilization Test

 - Exercise 5-8 Amino Acid Decarboxylation

 - Exercise 5-14 Gelatin Hydrolysis

 - Exercise 5-15 Urea Hydrolysis

 - Exercise 5-18 SIM Medium

 - Exercise 9-1 Identification of Enterobacteriaceae

 - Exercise 9-5 EnteroPluri-Test

 - Exercise 7-2 Antibiotic Susceptibility Test (Kirby-Bauer Method)

Week 9. **C&S: Unknown Identification Lab and Antibiotic Selection** (Oct 29th – Nov 3rd)

 Students read pp. 573-574

 - Exercise 9-1 Identification of Enterobacteriaceae (analysis)

 - Exercise 9-5 EnteroPluri-Test

 - Exercise 7-2 Antibiotic Susceptibility Test (Kirby-Bauer Method) (analysis)

Week 10. **DNA Lab** (Nov 5th – 10th)

 - Exercises 2-12 and 8-2 The Lethal Effect of Ultraviolet Light on Microbial Growth

 -instructors read handout to see how this lab will be performed differently from the book

 - Exercise 8-3 Bacterial Transformation: the pGLO System

Week 11. **Immunology lab** (Nov 12th – 17th)

 - Analysis of last week’s experiments

 - Exercise 8-6 ELISA Test (HIV simulation test)

 - Exercise 7-4 Epidemic Simulation (Influenza party☺)

*There are no labs scheduled for Nov 19th -24th due to the Thanksgiving holiday!!*

Week 12. **Human Microbiology/Epidemiology Analysis** (Nov 26th – Dec 1st)

 - Analysis of previous lab’s experiment

 - Exercise 6-4 Differential Blood Cell Count

 **Review**

Week 13. **FINAL LAB EXAM** (Dec 3rd – 8th)

 - Exam on lab experiments performed during weeks 6-12