MICR 3700 Medical Microbiology (4 units) Fall 2019

Section 01 (Class# 92878) Lecture MW 12:15 – 1:30 pm BIOS 352 (Deisy Contreras)

Section 02 Class# 92879) Laboratory M 1:50 – 4:20 pm ASCL 229 (Bita Bahrami)

Section 03 (Class# 93430) Laboratory W 1:50 – 4:20 pm ASCL 229 (Bita Bahrami)

**Lecture Instructor:** Dr. Deisy Contreras

Contact: [dcontr69@calstatela.edu](mailto:dcontr69@calstatela.edu) (preferred; you can contact me anytime by email); Phone: (in emergency only): 323 343 2050; Student hours: MW 11:30 am – 12:00 pm (schedule directly with me) Location: TPalmer Wing Library 2097

**Laboratory Instructor:** Bita Bahrami

Contact: [bbahram4@calstatela.edu](mailto:bbahram4@calstatela.edu); Phone (in emergency only): 323 343 2050; Student hours: Palmer wing library 2097, MW 11:00 am – 12:00 pm or by appointment

**Course description:**

* Host-pathogen interactions; microbiology and pathophysiology of infectious diseases with an emphasis on bacterial infections; diagnostic procedures for identification of major human pathogens including microscopy, isolation, culture, and biochemical assay. Lecture 3 hours and laboratory 3 hours per week.

**Prerequisites:**

* MICR 3100/BIOL 3100 or equivalent with grade of C or higher, or instructor consent

**Student learning goals:**

* To demonstrate an understanding of the impact of microbes in health and disease
* To understand and describe the principles of the infection cycle with special attention to pathogen interaction with the host, and measures used to break the cycle
* To discuss the impact of research on the field
* To acquire the skills necessary to work with and identify infectious disease agents and to become familiar with the work flow and diagnostic algorithms in a clinical laboratory
* To develop enhanced critical thinking skills and the ability to work in small teams
* To become aware of one’s role in the health care system depending on career choice

**Required texts and materials:**

* Textbook of Diagnostic Microbiology, 6th Edition 2019; By Connie R. Mahon and Donald C. Lehman, Elsevier, Inc., St. Louis, Missouri, ISBN: 9780323613170. This book will be also on reserve at the library reference desk (loan period 1 day).
* A Photographic Atlas for the Microbiology Laboratory 4th Edition by Michael J. Leboffe (Author), Burton E. Pierce (Author); Morton Publishing Company; ISBN: 978-0895828729 or 0895828723
* The lab manual (which will also serve as laboratory notebook) is posted online
* Students are required to purchase a designated blood borne pathogen and chemical reagent resistant lab coat (KleenGuard A60) for ONE TERM use which will be stored in the lab when not in use and safely discarded upon completion of the course. The lab coat can be purchased from the University Bookstore or other sources.

**Attendance**

* Regular attendance is required for participation in collaborative projects and active learning exercises. Attendance is mandatory for the laboratory section and there are no make-up lab sessions. Course credit will not be given if more than 3 laboratory sessions have been missed excepting extraordinary circumstances that are properly documented. For certain laboratory exercises, students must return the following day outside of regular class time to complete the exercises.

**Lecture PowerPoints and course related materials:**

* Accessible via **Canvas** (CalState L.A. email account and access to GET is required for all students). The course will be entirely run through the lecture section.
* Some of the lectures will be posted as narrated video clips for self-study.

**Collaborative project based learning (CPBL)**

* This course includes several types of collaborative learning including active learning such as minute papers, take home message, pair and share, and mini case studies.
* To enhance the Fink dimensions caring, human dimension, and learning that form part of Fink’s matrix of significant learning (L. Dee Fink. Creating significant learning experiences. 2013.John Wiley & Sons, Inc.), there will be a term spanning collaborative project, a case study developed by the students who will work in a group of 4 - 7 members depending on the class size. The final product will be a written paper (individually written, in sections, throughout the term, peer reviewed prior to submission) and a group PowerPoint presentation during the last class meeting. There will be additional detailed information posted on **Canvas**. In the laboratory, students will work most of the time as a team.

**Quizzes and exams**

* **Weekly post-lecture quizzes** will be administered via **Canvas** (open from Thursday night until Sunday night, two attempts, highest score counts). Exams given during lecture class time will consist of a variety of questions including multiple choice, short answers, fill-ins, matching, and analysis of representative experimental results or identification of microscopic images. For the lecture final exam you will need to bring a scantron with 50 points per side (form no- 882-E). Lab quizzes will be also administered via **Canvas** but as **PreLab** quizzes to ensure that students will come prepared to the labs (open Thursday night and close at 8:00 am on Monday; **one attempt only**). The lab midterm and final will be online.

**Flow charts**

* In clinical microbiological diagnostic laboratories, it is impossible to perform all available tests on one specimen due to time and cost constraints. Therefore, to identify an unknown isolate decision trees are followed where the outcome of initially selected screening assays dictate the subsequent tests. To familiarize students with these clinical algorithms students will create flow charts for a recommended work up of selected bacterial isolates. Initially, this will be team work. The bacteriology section will be concluded with 2 unknowns which students have to identify through individual work and developing an individual flow chart.

**Laboratory report**

* There will be one formal laboratory report to enhance students’ formal scientific writing skills. This report will be individually prepared. Specific requirements will be discussed during class and a rubric will be made available on **Canvas**.

## Extra credit:

* Students may earn extra credit points, for example for outstanding contributions to class discussions, news clips that are shared with the class, excellent laboratory performance, excellent record keeping in the laboratory notebooks, and constructive suggestions aimed to improve the course.

**Point deductions:**

* Unexcused late arrivals to the laboratory sections will lead to point deductions (5 pts each time). Failure to keep the laboratory work space clean will also result in point deductions.
* **Assignments turned in late will not be accepted**.

## General policies:

* No make-up examinations. Missed events will be set as “0 points” unless satisfactorily justified with supporting documentation (e.g. doctor’s note). Students are responsible to obtain the missed information from their team mates and through self-study. There will be no make-up instruction.
* Laboratory section: students are required to wear a blood borne pathogen and chemical reagent resistant lab coat and closed toe shoes, and must have a notebook and color pencils. Gloves will be provided when needed. Students with latex allergy must contact the instructor without delay. Students without a lab coat cannot participate and the affected lab section will be recorded as missed.
* The Drop/Incomplete and Academic/Honesty policies explained in the University General Catalogue will be strictly followed. Students are expected to read and abide by the University’s Academic Honesty Policy (http://www.calstatela.edu/sites/default/files/groups/Judicial%20Affairs/Docs/academic\_honesty.pdf).  Students who violate this policy will be subject to disciplinary action, and may receive a failing grade in the course for a single violation.
* Students with disabilities: Reasonable accommodation will be provided to any student who is registered with the Office for Students with Disabilities and requests needed accommodation.
* Students are strongly encouraged to work with the instructors throughout the course. Students can email anytime and responses can be expected within a day.

### Performance evaluation: 900 points total

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| Lecture:  100 | 600 points  Weekly Quizzes (15 x 5 - 7 pts, online via Canvas) |
| 100 | Mini-Midterm I and II (50 points each) |
| 50  150 | Mini case studies (group work, 10 points each)  Collaborative project based learning: Term case study (individual term paper (100 pts) and group PowerPoint presentation (50 pts) |
| 30 | Active learning |
| 170 | Final exam (comprehensive) |
| Laboratory:  60  40 | 300 points  PreLab Quizzes (12 pre-lab quizzes with 5 pts each, online via **Canvas**)  Flow charts (team work, 4 with 10 pts each) |
| 50 | Unknown (individual work, appropriate selection of biochemical assays, flow chart and correct identification) |
| 30 | HIV testing report (ELISA and RT-PCR) |
| 50  70 | Lab midterm (online)  Lab final exam (comprehensive, online) |

Grades: Based on the total points achieved (including extra credit) students will earn*:*

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|  | *B+: ≥ 86 % (774 pts)* | *C+: ≥ 76 % (684 pts)* | *D+: ≥ 66 % (594 pts)* |
| *A : ≥ 92 % (828 pts)* | *B : ≥ 82 % (738 pts)* | *C : ≥ 72 % (648 pts)* | *D : ≥ 60 % (540 pts)* |
| *A- : ≥ 89 % (801 pts)* | *B- : ≥ 79 % (711 pts)* | *C- : ≥ 69 % (621 pts)* | *F: <60 % (below 540 pts)* |

**Study suggestions**:

* Assign time for study and block this time in your schedule

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| **Time** | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** | **Sunday** |
| **8a** |  |  |  |  |  |  |  |
| **9a** |  |  |  |  |  |  |  |
| **10a** |  |  |  |  |  |  |  |
| **11a** |  |  |  |  |  |  |  |
| **12p** | Lec |  | Lec |  |  |  |  |
| **1:30p** | Lec |  | Lec |  |  |  |  |
| **2 p** | Lab-02 |  | Lab-03 |  |  |  |  |
| **3p** | Lab-02 |  | Lab-03 |  |  |  |  |
| **4p** | Lab-02 |  | Lab-03 |  |  |  |  |
| **5p** |  |  |  |  |  |  |  |
| **6p** |  |  |  |  |  |  |  |
| **7p** |  |  |  |  |  |  |  |
| **8p** |  |  |  |  |  |  |  |
| **9p** |  |  |  |  |  |  |  |
| **10p** |  |  |  |  |  |  |  |
| **11p** |  |  |  |  |  |  |  |

* Keep track each week how many hours you are studying and in which ways. Remember that per unit 2 – 3 hours study time outside of class are required for a good grade.
* Always read the text and the PowerPoints and take the required post-quizzes and pre- quizzes after you have reviewed the material and summarize each week what you have learned.
* Take very good notes - anything what was explained or commented on verbally may be tested in the quizzes and exams.
* Form study groups and force yourself to explain the material you have learned.
* **Create multiple tables that organize the teaching material from different viewpoints**.
* Learn to recognize when you need help, and get help in a timely manner (visit office hour, email instructor, tutor center).
* Study, study, study, study, study........

**MICR 3700 Medical Microbiology Planned Schedule Fall 2019\***

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| **Week/Day** | **Date** | **Lecture\*\*** | **CPBL** | **Laboratory** |
| 1/  W | 8.21.19 | **Course expectations**  **Setting the stage:**  Overview of major infectious diseases | Outside of class: screen news for pathogen of interest | ***No Labs*** |
| 2/  MW | 8.26.19/  8.28.19 | **Host defenses**  Normal microbiota  General defenses | Formation of CPBL groups  Select a pathogen | Biosafety and lab rules  Normal microbiota: Effectiveness of hand scrubbing |
| 3/  MW | 9.02.19/  9.04.19 | ***Labor Day***  Innate Immunity | ***Labor Day*** | ***No Labs*** |
| 4/  MW | 9.09.19/  9.11.19 | Library workshop (Room TBA)  Innate Immunity | Demonstration: literature search  Describe the disease symptoms and provide a list of potential pathogens to be considered for differential diagnosis | Microcopy and Staining  Primary and differential culture media |
| 5/  MW | 9.16.19/  9.18.19 | Adaptive Immunity  Adaptive Immunity | Create a biography for a fictional patient | Normal microbiota skin |
| 6/  MW | 9.23.19/  9.25.19 | **Host pathogen interaction**  Overview of microbial pathogenicity factors  Opportunistic and primary pathogens | Create a scenario on how the disease was transmitted | Normal microbiota airways |
| 7/  MW | 9.30.19/  10.02.19 | **Epidemiology**  Infection cycle and transmission of infectious disease agents  **Laboratory diagnosis**  Specimen collection and processing  Specimen examination and cultivation  Laboratory diagnostic approaches  Laboratory quality assurance | Select the specimens that should be submitted for the diagnosis  Explain verbatim to the patient what specimens are to be collected, how they will be collected, and how the specimens need to be transported  Address what tests need to be done in the clinical lab, and the results of the tests | Normal microbiota gastrointestinal tract |
| 8/  MW | 10.07.19/  10.09.19 | ***Mini-Midterm I (40 min)***  **General characteristics and overview of clinically relevant infectious disease agents**  Bacteria I | Each student retrieves 2 primary research papers related to the pathogenicity factors important for this pathogen | Normal microbiota urogenital tract |

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| **Week/Day** | **Date** | **Lecture** | **CPBL** | **Laboratory** |
| 9/  MW | 10.14.19/  10.16.19 | Bacteria II  Bacteria III | Select 2 primary research papers from your collection; provide a justification for the selection  At the molecular level explain pathogenicity factors of the pathogen (how does the pathogen act on the host and cause disease) and host pathogen interactions  Suggest a therapy and preventive measures  Describe potential side effects of the therapy that may mitigate compliance with the drug regimen | Diagnosis of bacterial pathogens of the blood stream and gastrointestinal tract (Unknowns) |
| 10/  MW | 10.21.19/  10.23.19 | Bacteria IV  Antimicrobial agents  Resistance to antimicrobial agents | Describe how the diagnosis is communicated from the lab to the physician and from the physician to the patient along with the therapy  Write out verbatim what the physician will say to the patient | Diagnosis of bacterial pathogens of the respiratory tract, nervous system, and fetal infections (Unknowns) |
| 11/  MW | 10.28.19/  10.30.19 | Viruses  Viruses | Describe how the fictional patient will respond to the news and compare that with your own feelings if you were informed of such a diagnosis | Antibiogram |
| 12/ MW | 11.04.19/  11.06.19 | ***Mini-Midterm II (40 min)***  Fungi | Anticipate effects of aborting the therapy  Develop a patient education plan  Provide a prognosis and describe the final outcome of your fictive case | Viral pathogen: HIV molecular diagnosis |
| 13/  MW | 11.11.19/  11.13.19 | ***Veteran’s Day***  Protozoa | ***Veteran’s Day***  Identify the professional role you would play in this case study based on your career path  Describe the consequences of low performance on your behalf in this scenario | ***No Labs*** |
| 14/  MW | 11.18.19/  11.20.19 | Helminths  **Differential diagnosis of major infectious diseases**  Gastrointestinal, respiratory infections, and skin infections | Peer review of the CPBL paper draft 1 (within the teams) | Viral pathogen: HIV immunological diagnosis  Fungal pathogens: culture |
|  | 11.25.19/  11.27.19 | ***Study time***  ***Thanksgiving*** | ***Study time***  ***Thanksgiving***  Peer review of the CPBL paper draft 2 (across teams, electronically) | ***No Labs*** |
| 15/  MW | 12.02.19/  12.04.19 | Urogenital, nervous system, and blood and tissue infections  **Guest Speaker: Dr. Omai Garner, UCLA** Pathology & Laboratory Medicine | Final CPBL paper upload  Preparation of PowerPoint | Fungal pathogens: culture and microscopic diagnosis  Parasitic pathogens: microscopic diagnosis of protozoa and helminths |
| 16/  M | 12.09.19 | Case study presentations | Final PowerPoint upload | **Final lab examination (online)** |

**Final Lecture Exam: Tentative Time: December 11, 12:00 – 2:00 pm, in BIOS 352**

\*Note: The schedule may be changed during the course. \*\*Some lectures will be narrated and posted for self-study

**MICR 3700 Medical Microbiology Detailed Lab Schedule Fall 2019**

Section 02 (Class# 92879) M 1:50 – 4:20 pm ASCL 229 Professor Bita Bahrami

Section 03 (Class# 93430) W 1:50 – 4:20 pm ASCL 229 Professor Bita Bahrami

Readings: Posted lab instructions and corresponding text in A Photographic Atlas for the Microbiology Laboratory, 4th edition by Leboffe and Pierce

*On some occasions, student must view cultures on the day following the experiment.*

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| **Week/Day** | **Lab #** | **Date** | **Laboratory** | **Strains provided** | **Reagent and media provided** |
| 1/W |  | 8.21.19 | ***No Labs*** | | |
| 2/  M/W | Lab 1 | 8.26.19/ 8.28.19 | Biosafety and lab rules  Normal microbiota: Effectiveness of hand scrubbing | None | Per class  Surgical scrub, soap (NOT antibacterial), hand lotion  5 basins filled with sterile water,  Per group (5 groups)  6 pour agar (NA) , 6 empty petri dishes, 1 mL pipettes |
| 3/  MW |  | 9.02.19/  9.04.19 | ***No Labs (Labor Day)*** | | |
| 4/  MW | Lab 2  Lab 3 | 9.09.19/  9.11.19 | Microcopy and Staining | Per table:  In broth: *S. aureus, C. xerosis, E. coli, M. catarrhalis*;  On LJ slant: *M. smegmatis* | Gram stain  Acid fast stain (hot and cold) |
| Primary and differential culture media | on TSA or NAslant: *S. aureus, C. xerosis, E. coli, K. pneumoniae, P. mirabilis, P. aeruginosa*  On CBA*: S.pyogenes,*  On choc: *Haemophilus species* | Per table  8 each: NA, TSA, CBA, CNA, MSA, Choc, Mac, HE, TSI  Candle jar (demo), CO2 incubator  Gram stain |
| 5/  MW | Lab 4 | 9.16.19/  9.18.19 | Normal microbiota skin | Per table  On CBA: *S.aureus*, *S. epidermidis*, *M. luteus*, *S. agalactiae,* *S. pyogenes*, *E. faecalis*, *C. xerosis, C. albicans*  <https://anaerobeeducator.com/> *Peptostreptococcus anaerobius, Propioniobacterium acnes* | Per student: *(for their own culture)*  1 CBA, sterile swab, TSB  Per table:  8 each CBA and SDA (with chloramphenicol), 2 MSA  6 Staph O/F Glu, mineral oil, 3 Coagulase,2 DNAse plates (methyl green), 3 BE, 3 x 6.5% NaCl,  Catalase, oxidase, PYR discs, Taxo A discs, forceps  Gram stain  Anaerobe poster/charts |

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| **Week/Day** | **Lab #** | **Date** | **Laboratory** | **Strains provided** | **Reagent and media provided** |
| 6/  MW | Lab 5 | 9.23.19/  9.25.19 | Normal microbiota airways | Per table:  On CBA: *S. sanguinis*, *S*. *pneumoniae*, *N. lactamica*, *M. catarrhalis*  On Choc: *H. influenzae*, *H. parainfluenzae*  <https://anaerobeeducator.com/> *Fusobacterium nucleatum, Fusobacterium necrophorum* | Per student: *(for their own culture)*  1 CBA, sterile swab  Per table:  *S. aureus* on CBA to be usedfor satellite (also for student cultures)  Per Table:  8 each CBA and Choc, 2 HaemQuad, 2 stripes CarbFerm  2 x 5 mL TSB (for HaemQuad), 2 sterile swabs  Catalase, oxidase reagent, Taxo P discs, forceps  Gram stain  Anaerobe poster/charts |
| 7/  MW | Lab 6 | 9.30.19/  10.02.19 | Normal microbiota gastrointestinal tract | Per table:  On CBA: *E. coli; K. pneumoniae, E. cloacae, C. freundii, P. mirabilis, P. vulgaris, P. aeruginosa, A. lwoffii*  <https://anaerobeeducator.com/> *Bacteroides fragilis, C. difficile,* *Clostridium perfringens, Porphyromonas ssp.* | Per table:  8 each Mac, HE,  8 each TSI, MR, VP, citrate, urea, PA , LIA, motility, nitrate  Spot indole, catalase, oxidase  Gram stain  Anaerobe poster/charts |
| 8/  MW | Lab 7 | 10.07.19/  10.09.19 | Normal microbiota urogenital tract | Per table:  On CBA *S. aureus, S. saprohyticus, S. agalactiae, E. faecalis, G. vaginalis*, *L. lactis*  On LJ: *M. smegmatis*  <https://anaerobeeducator.com/> *Campylobacter* (*Bacteroides) ureolyticus, Prevotella intermedia* | Regents to complete MR (methyl red), VP (Barritt A,B), PA (ferric chloride), nitrate (Nitrate A,B, zinc)  Per table:  2 MSA, 2 x 100 mm MH, 2 CBA, 2 BE, 2 V agar, 2 x 5 mL TSB  Catalase, 2 rapid hippurate, Clumping factor slide agglutination (staphylase), PYR discs, Taxo A, Novobiocin discs, forceps  Gram stain, Acid fast stain  Anaerobe poster/charts |

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| **Week/Day** | **Lab #** | **Date** | **Laboratory** | **Strains provided** | **Reagent and media provided** |
| 9/  MW | Lab 8 | 10.14.19/  10.16.19 | Diagnosis of bacterial pathogens of the blood stream and gastrointestinal tract (Unknowns) | Per table, coded (“Unknowns”)  On CBA in 4QI: *E. coli, Salmonella* Typhimurium*, Shigella flexneri (attenuated), Y. enterocolitica, A. hydrophila, P. multocida, P. aeruginosa, A. lwoffii* | Per table:  8 each CBA, Mac, HE, XLD, CIN, TSI  16 each motility (for RT and 37C)  Catalase, oxidase reagent  Per student:  MID64/65, mineral oil, 3 mL sterile saline and 5 mL sterile saline, and 1 CBA for purity check |
| 10/  MW | Lab 9 | 10.21.19/  10.23.19 | Diagnosis of bacterial pathogens of the respiratory tract, nervous system, and fetal infections (Unknowns) | Per table, coded (“Unknown”):  On CBA in 4QI: *S. pneumoniae,* S*. agalactiae, L. monocytogenes, K. pneumoniae, P. aeruginosa*  On Choc: *N. meningitidis, M. catarrhalis, H. influenzae* | Reagents to complete MID64/65 (Nitrate A,B, C [zinc powder]; Indole Kovacs reagent, VP reagent A,B, ferric chloride for TDA), Software MID60  Gram stain  Catalase, oxidase  Per table:  8 CBA, 8 Mac, 4 Choc, 1 HaemQuad, 8 Motillity (RT and 37°C)  Taxo P, PYR discs, 2 Rapid hippurate, forceps  2 stripes Carboferm  3 stripes MID64/MID65, 3 sterile saline with 3 mL each and 3 sterile saline and with 5 mL each, 3 CBA for purity check, mineral oil |
| 11/  MW | Lab 10 | 10.28.19/  10.30.19 | Antibiogram | Per class:  On TSA*: S. aureus, E. faecalis, E. coli, E. cloacae, P. vulgaris, P. aeruginosa* | Reagents to complete MID64/65 (Nitrate A,B, C [zinc powder]; Indole Kovacs reagent, VP reagent A,B, ferric chloride for TDA), Software MID60  Per group:  ETest (Biomerieux, US S30 stripes; BENZYLPENICILLIN (PGL 256) , CEFTRIAXON (TX 256), CEFTAZIDIME (TZ 256), VANCOMYCIN (VA 256), LEVOFLOXACIN (LE 32), AMIKACIN (AK 256) or as available), forceps  1 x each 150 mm MH and sterile saline (10 mL)  sterile swabs  MIC set up per group:  1 general assay microtiter plate, multichannel pipette up to 20 L and up to 300 L with fitting tips, gentamicin 6.4 mg/mL, penicillin 6.4 mg/mL, 10 mL sterile water, 10 mL sterile saline, 10 mL sterile MH broth |
| **Week/Day** | **Lab #** | **Date** | **Laboratory** | **Strains provided** | **Reagent and media provided** |
| 12/  MW | Lab 11 | 11.04.19/  11.06.19 | Viral pathogen: HIV molecular diagnosis | None | Per group:  Edvotek: RT PCR HIV replication #335- Part 1  Ice buckets for each group |
| 13/  MW |  | 11.11.19/  11.13.19 | ***No Labs (Veteran’s Day)***  **Lab midterm (online)** | | |
| 14/ MW | Lab 12 | 11.18.19/  11.20.19 | Viral pathogen: HIV immunological diagnosis  Fungal pathogens: culture | Per table:  On CBA, grown for 2 days at 30°C: *C. albicans, C. tropicalis, C. glabrata, C. krusei* | Per group:  Edvotek: RT PCR HIV replication #335- Part 2  Per group:  Edvotek: HIV ELISA #271  Gram stain reagents  Per group:  4 each Chromagar |
|  |  | 11.25.19/  11.27.19 | ***No Labs (Thanksgiving)***  **HIV report due** (Sunday, Dec.1st, 23:55 pm) | | |
| 15/  MW | Lab 13  Lab 14 | 12.02.19/  12.04.19 | Fungal pathogens: culture and microscopic diagnosis  Parasitic pathogens: microscopic diagnosis of protozoa | Per table:  On SDA: *Penicillium notatum, Aspergillus niger, Rhizopus stolonifer* | Per group:  4 each germ tube tests  Mycomount, glass slides, gloves  Review Anaerobes  Per table:  Demo slides (set up for students by instructor)- protozoa (100x w/ oil)  *Entamoeba histolytica (*cysts and trophozoites), *Plasmodium falciparum* (ring stage and gametocytes), *Trypanosmoa cruzi* (trypomastigote), *Giardia lamblia* (cysts and trophozoites), *Trichomonas vaginalis* (trophozoites), *Balantidium coli* (trophozoites)  Digital slides: <http://www.brown.edu/Courses/Digital_Path/systemic_path/GI.html> |
| Parasitic pathogens: microscopic diagnosis of helminths | None | *Demo slides* (set up for students by instructor)- helminths (10x)  *Taenia solium* (scolex, cysticercus), *Taenia pisiformis* (eggs); *Schistosoma mansoni* (eggs), *Schistosoma haematobium* (eggs), *Ascaris lumbrocoides* (eggs), Hookworm (eggs), *Enterobius vermicularis* (eggs)  Digital slides: <http://www.brown.edu/Courses/Digital_Path/systemic_path/GI.html> |
| 16/  M | **Lab Final** |  | **Final lab examination (online)** | | |