Appendix I: Information about Lab Practical Exams

During the course of the semester, there will be two lab practical exams: the Midterm Practical and the Final Practical. The midterm practical will occur in several steps beginning in week 5 and extending through week 10. The final practical will occur on the last day of class.
The practical exams are each worth 20% of your lab grade. Each practical exam has a different format.

The Midterm Practical is an open book exam in which you will use Gram staining and metabolic tests to determine the identity of two bacterial unknowns, and write a lab report based on your results. A more complete description of what is required for the midterm and lab report can be found below.

The Final Practical is a cumulative exam that is **not open book**. Twenty five stations will be set up around the lab, and you will be expected to answer questions about the material at these stations. You may be asked to identify microorganisms, analyze the results of a metabolic test or interpret the results of an experiment. Since the exam is cumulative, it can cover material from the first lab through the last lab of the class. The Microbiology Review site on Blackboard contains material that will help you review the material that you have covered throughout the semester.

Midterm Practical

This first lab practical involves the identification of two unknown bacteria using both Gram staining and metabolic assays. There are 3 parts to this lab practical—Part I: Gram staining (Lab 5); Part II: Preparation of dichotomous key (Lab 6) and metabolic testing (Lab 7); Part III: a written lab report (due on Lab 10). Each part of the lab practical is graded separately (see below). This first lab practical is an open book exam. You are being tested on your ability to correctly perform procedures and interpret results. Although you can use your books and your notes, you **cannot** seek the advice or assistance of other students or the instructor!

Schedule for Midterm Practical

Lab 5: You will be given two unknown bacteria and asked to Gram stain them following the procedures you have learned in previous labs. After Gram staining, you will observe the cells under the microscope, and determine their morphology and Gram reaction. At the end of the lab period you will submit your results (see sample sheet below) to your instructor for grading. Your slide will be saved and may also be photographed for use in your lab report.
Note: You will be required to show the results of your Gram staining procedure to your instructor. Make sure you don't wait until the last minute to call the instructor over to view your slides!

Lab 6: You will learn how to construct a dichotomous key for bacterial identification. Using what you know about the Gram reactions of your unknown bacteria as well as information about the metabolic reactions of bacterial species obtained in Lab 5, you will construct a dichotomous key that can be used to identify your 2 unknown bacteria. You will also choose the media that you will need to use for the inoculations you will do in the next lab. You will turn in the dichotomous key for grading and the instructor will return it to you on Lab 7 (corrected if necessary).

Lab 7: You will inoculate your unknown bacteria in the media that you chose in Lab 6.

Lab 8: You will analyze the results of your metabolic tests. Using these results and your dichotomous key, you will identify your two unknown bacteria.

Lab 10: You will turn in the Lab Report for the Midterm Practical.

Midterm Practical Grading

Point Distribution—out of 100%:

Gram reactions: 25%

Metabolic assays: 25%

Written lab report: 50% (see Lab Report Rubric)

Grading Breakdown:

Part I: Gram Reactions (25/100)

Morphology for unknown A correct – 5 points

Morphology for unknown B correct - 5 points

Gram reaction for unknown B: color and interpretation is correct - 5 points

Gram reaction for unknown B: color and interpretation is correct - 5 points

Unknown A slide shown to professor - 2.5 points

Unknown B slide shown to professor - 2.5 points

Part II: Metabolic Assays (25/100)

Dichotomous key- complete and correct - 5 points

Media required based on student's key complete and correct - 5 points

Metabolic test results recorded and interpreted correctly - 15 points

Part III: Lab Report (50/100)

Lab Report

General Guidelines

1. Lab reports must be typed—no handwritten reports will be accepted! Font size should be no larger than 11 or 12. The lab report format is described below.

2. While writing your lab report, please remember that everything must be in your own words. There is a no tolerance policy on plagiarism. Your instructors can Google along with the best of you. If they find that segments of your lab report are copied word-for-word from another source (e.g., from the web, your lab handouts or text book), you will receive a 0 for that lab report. If they find that lab reports from different people are word-for-word copies, all involved will receive a 0 for their lab reports.

3. Approximate length. The lab report should be at least 2 pages of text (not including figures, tables, pictures and references)

4. Make sure to include the **original, graded** sheets of the following items:

a. Gram stain results

b. Dichotomous key/required media

c. Metabolic test results

(These can be placed at the end of the lab report if you want to make neater, corrected copies for your lab report.)

Lab Report Format

TITLE

You should have an appropriate title for your lab report. Include on your title page: your name, your instructor's name, and your class section.

Your lab report should be divided into the sections listed below. Pay careful attention to what material belongs in each section. **Each of the sections should be labeled** in the lab report.

INTRODUCTION

In this section you should discuss the importance of bacterial identification procedures. This section should also include general background information about the use of the Gram stain and metabolic tests to identify bacteria and you should discuss why staining procedures alone are not sufficient for bacterial identification. (2-3 paragraphs)

METHODS

In this section, you should explain the steps followed to identify your unknowns. For the Gram stain procedure, you may simply reference the lab manual, unless you have deviated from the protocol (if you do anything different from the instructions, you should explain that here). This section should also include the dichotomous key that you used to set up your experiments, and you should describe the rationale that led you to the formation

of this key. You should also describe each metabolic test you used (name the medium, describe the inoculation procedure, describe any procedures necessary post-inoculation and explain what metabolic process you are testing for). (3-4 paragraphs)

RESULTS

This section will be used to present your results for the Gram stain and the metabolic tests. Divide this section into 2 parts: 1 part for each of your unknowns.

Example:

Unknown 1A

Gram stain results. Describe color, Gram reaction, morphology and arrangement. Include either a photograph or a color drawing here. Students can use the microscope at the instructor's desk to take a picture, which can then be saved to a flash drive and printed out to be added to the lab report. The photograph added to the lab report should be in color. If you make a drawing, it must also be in color, and make sure that the bacteria's morphology and characteristic arrangement (if any) can be seen. Drawings/photographs should be labeled. You should include the table that you filled out in Lab 5, but you must also describe your Gram staining results in the body of the lab report.

Metabolic Test results. You should include the table you filled out in Lab 8, but you must also summarize your results in the body of the lab report. You need to describe the results (colors, bubbles, etc.), make a determination as to whether the result is a positive or a negative result, and then interpret the result. For example: "After inoculation my urea slant turned pink. This was a positive result, indicating that this bacteria produces a urease."

Unknown 1B (as above for Unknown 1A)

(1-2 paragraphs for each unknown, not including the tables.)

CONCLUSIONS

It is here where you will make your identification of your unknowns based on the results of the Gram stain and the metabolic tests. Divide it into 2 sections, 1 for each unknown. Describe in words and sentences your rationale for making your final identifications. If you have any problems or inconsistencies with your experiments (ex: an incorrect result for your gram stain or a metabolic test result that is not consistent with your bacterial identification), you should discuss them here. Try to explain what might have happened to give you an incorrect result.

Also include in this section an additional test that would confirm your results for each unknown. This is a test that you did not perform; it could be a staining procedure or an additional metabolic assay. **Make sure you mention the expected result for these additional tests.**

After you have discussed the identification of your unknowns, include 1-2 paragraphs about each of your identified bacteria. This section should include what your test results tell you about the bacteria's structure, morphology, and metabolism. Also add some general information about the bacteria, including any diseases that this species has been shown to cause. You can use your textbook to obtain this information, or use the following websites:

- CENTERS FOR DISEASE CONTROL AND PREVENTION: Contains information about infectious diseases, their causes, treatments, epidemiology and prevention.
- http://www.cdc.gov/

AMERICAN SOCIETY FOR MICROBIOLOGY: allows for searches of their journals; also contains links to current information about Microbiology and Microbiology education.http://www.asm.org/

- NATIONAL LIBRARY OF MEDICINE, part of the National Institutes of Health; includes information on infectious diseases; search engine can be used to find current information on a particular topic

http://www.nlm.nih.gov/

- CELLS ALIVE: links to information about bacteria, viruses and eukaryotic pathogens
- http://www.cellsalive.com/inex.htm
- OTHER RESOURCES MAY BE USED BUT PLEASE MAKE SURE THEY ARE RELIABLE (WHEN IN DOUBT ASK YOUR INSTRUCTOR!)

DO NOT RELY ON WIKIPEDIA!

The Lab Report will be due on Lab 10. Lab reports that are turned in late will have **5 points** deducted for each day they are late. No reports will be accepted after lab 11—no exceptions!

Suggestions for writing a good lab report:

1. Have someone proofread your lab report before you turn it in.

2. Use the grading rubric for the lab report (see below) as a checklist to make sure that you formatted the lab report correctly, and that you have all the required information.

2. The Campus Writing Center is located in the Library (L-118). You can visit them for additional help with your writing.

Sample Forms you will fill out for Midterm Practical

Gram Stain Results

Name: _____ **Unknown Number _____**			
Unknown	**Color after Gram stain**	**Gram reaction (positive or ne*g*ative)**	**Morphology**
A			
B			

Results from Metabolic Tests

Name: _____

Unknown number: _____

	A		B	
Test	**Describe result**	**Result (+ or -)**	**Describe result**	**Result (+ or -)**
Catalase				
Simmon's citrate (Citrate permease)				
Indole (Tryptophanase)				
Urease				
Amylase				
Gelatinase				
Lactose fermentation				

Fill in only for the tests you have performed. Result descriptions could include colors, presence/absence of bubbles, colored or colorless zones around inoculation regions, etc., depending on the test used. Based on the appearance of your test, determine if the result was positive (+) or negative (-)

Microbiology Lab Report Grading Rubric

Introduction (max 8 points)	Student properly explains the importance of bacterial identification and why both staining and metabolic tests are necessary **7-8 points**	Student offers some explanation of the importance of bacterial identification and why both staining and metabolic tests are necessary **5-6 points**	Student offers little explanation of the importance of bacterial identification and why both staining and metabolic tests are necessary **3-4 points**	Student offers very little or no explanation of the importance of bacterial identification and why both staining and metabolic tests are necessary **0-2 points**
Methods (max 10 points)	• Student clearly explains how dichotomous key was generated and used to choose appropriate metabolic tests • Dichotomous key is correct and neatly organized • All of the expected information about the basic chemistry behind each metabolic test chosen is provided • Student identifies Gram staining method used and mentions any changes to procedure **8-10 points**	• Student provides some explanation about how dichotomous key was generated and used to choose appropriate metabolic tests • Dichotomous key contains one error and/or is somewhat disorganized • Most of the expected information about the basic chemistry behind each metabolic test chosen is provided **6-7 points**	• Student provides inadequate information about how dichotomous key was generated and used to choose appropriate metabolic tests • Dichotomous key contains several errors and/or is difficult to interpret • Some information about the basic chemistry behind each metabolic test chosen is provided **3-5 points**	• Student provides little to no explanation about how dichotomous key was generated and used to choose appropriate metabolic tests • Dichotomous key contains multiple errors and/or is impossible to interpret • Little to no information/inaccurate information about the basic chemistry behind each metabolic test chosen is included • Student does not identify Gram stain method used **0-2 points**
Results (max 10 points)	• All gram stain results (morphology, arrangement, and gram reaction) are explained correctly • All metabolic test results (appearance of media and interpretation) are explained completely and correctly • Both tables (gram stain and metabolic test results) with all correct information are included • Labeled drawings or photographs of slides (A and B) are included **8-10 points**	• Most gram stain results (morphology, arrangement, and gram reaction) are explained correctly • Most metabolic test results (appearance of media and interpretation) are explained completely and correctly • Both tables (gram stain and metabolic test results) with mostly correct information are included • Drawing or photographs of slides (A and B) are included **6-7 points**	• Some gram stain results (morphology, arrangement, and gram reaction) are explained correctly • Some metabolic test results (appearance of media and interpretation) are explained completely and correctly • Both tables (gram stain and metabolic test results) with some correct information are included • Drawings or photographs of slides are included but inadequate (A and B) **3-5 points**	• Gram stain results (morphology, arrangement, and gram reaction) is either missing or incorrect • Little or none of the metabolic test results (appearance of media and interpretation) are explained correctly • Tables (gram stain and metabolic test results) are missing or incorrect • Drawings or photographs of slides (A and B) are missing **0-2 points**

Conclusion (max 10 points)	• Both unknowns A and B are correctly identified, and student fully explains rationale for their identification • An appropriate additional test for each organism that would confirm its identity is explained • An appropriate explanation for any incorrect or inconsistent results is provided • An appropriate summary of the bacterial characteristics determined by their experiments is provided • Student provides adequate background information about both species from outside sources (text, web resources) **8-10 points**	• Both unknowns A and B are correctly identified, and student mostly explains rationale for their identification • An additional test for each organism that would confirm its identity is explained • Some explanation for any incorrect or inconsistent results is provided • Some summary information about the bacterial characteristics determined by their experiments is provided • Student provides some background information about both species from outside sources (text, web resources) **6-7 points**	• One unknown is identified correctly and/or student inadequately explains rationale for their identification • An additional test for one organism that would confirm its identity is explained • Little explanation for any incorrect or inconsistent results is provided • Little and/or inaccurate summary information about the bacterial characteristics determined by their experiments is provided • Student provides little and/or inaccurate background information about both species from outside sources (text, web resources) **3-5 points**	• Neither unknown is correctly identified and/or student does not explain rationale for their identification • No additional tests for either organism that would confirm their identity is explained • no explanation for any incorrect or inconsistent results is provided • No summary information about the bacterial characteristics determined by their experiments is provided • Student provides no background information about either species from outside sources (text, web resources) **0-2 points**
References (max 6 points)	• References and citations are used correctly • All references used are appropriate • Report is clearly written in the student's own words **5-6 points**	• References and citations are sometimes used correctly • Most references are appropriate **3-4 points**	• Either references or citations are missing or not used correctly • Some references are appropriate **1-2 points**	• Both references and citations are missing or not used correctly • References are not appropriate **0 points**
General overview and format (max 6 points)	• All topics are covered in the appropriate sections • Document is free of spelling and grammar errors • Text follows a logical order and is easy to understand • An appropriate font and page layout is used • An appropriate title is provided **5-6 points**	• Most topics are covered in the appropriate sections • Document contains few spelling and/or grammar errors • Text is fairly easy to follow and understand • Font and page layout are acceptable **3-4 points**	• Some topics are covered in the appropriate sections • Document contains some spelling and/or grammar errors • Some text does not follow a logical order and is difficult to understand • Font and page layout generally acceptable **1-2 points**	• Many topics are covered in the wrong sections • Document contains many spelling and grammar • Text does not follow a logical order and is extremely difficult to understand • Font and page layout is not acceptable • Title is missing **0 points**

How to Create a Proper Works Cited Page

(Source: http://www.livebinders.com/play/play?id=1156347)
A works cited page is required for any assignment that asks you obtain information from sources written by someone else. Ask your teacher how to include a type of source that is not listed below.

If you are using a ….

A Book with one author:
Last Name, First Name. *Title of Book*. Place of Publication: Publisher, Year of Publication. Print.

A Book with two authors:
Last Name, First Name and First Name Last Name. *Title of Book*. Place of Publication: Publisher, Year of Publication. Print.

A Book with three authors:
Last Name, First Name, First Name Last Name, and First Name Last Name. *Title of Book*. Place of Publication: Publisher, Year of Publication. Print.

A Book with more than three authors:
Last Name, First Name, et al. *Title of Book*. Place of Publication: Publisher, Year of Publication. Print.

An Encyclopedia Entry:
Last Name, First Name (if available). "Name of Entry." *Title of Encyclopedia*. edition. Copyright year. Print.

A Website:
Last Name, First Name (if available). "Title of webpage." *Title of Entire Website*. Date of posting/revision. Date of publication. Web. Date of access.

A Newspaper or Magazine Article:
Last Name, First Name. "Title of Article." *Title of Magazine*. Date of Article: Page(s). Print.

An Online Newspaper or Magazine Article:
Last Name, First Name. "Title of Article." *Title of Newspaper*. Date of Article. Web. Date you viewed the webpage.

An Online Database:
Last name, First name. "Title of article." *Title of journal or magazine:* Pages (if available). *Title of Database*. Web. Date of access.

A DVD Video:
Title of film or video. Film studio or distributor, Release year. DVD.

An Online Video:
"Title of Video." *Website*, Year Posted. Web. Date Viewed.

This is what your works cited page should look like*....*

Works Cited

Batchelor, John and James Davidson. *The American Nation.* New Jersey: Prentice Hall, 1994. Print.

"Biography of Franklin D. Roosevelt." *The White House.* Web. 26 Sept. 2009.

"George Washington." *World Book Encyclopedia.* 3rd ed. 1996. Print.

Glory. TriStar Pictures, 1989. DVD.

O'Brien, Steven. "Bill Clinton." *American Government*. ABC-CLIO, 2012. Web. 18 Aug. 2012.

"President Barack Obama's Inaugural Address." *Youtube*, 2009. Web. 18 Aug. 2012.

Rubel, David. *Scholastic Encyclopedia of the President.* New York: Scholastic, 1994. Print.

Sisk, Richard. "President Obama blasts Iran for secret nuclear facility." *New York Daily News*. 12 July. 2009. Web. 26 Sept. 2012.

Note:

- All entries are in **alphabetical** order.
- Books, websites, newspaper and magazine articles, etc. are ***NOT separated by type.***
- **All punctuation marks must be in the proper place!!**
- All entries that go onto a second line are **indented**, are lined up, and single-spaced.
- The entries ***are not*** numbered or bulleted.
- There is a line skipped between entries. All entries are **lined up**.
- All titles are *in italics*.
- All entries in your work cited must indicate what type of source it is (e.g. "Print", "Web", etc.)
- The online database ABC CLIO gives the proper citation at the end of each article.
- All dates are listed : Day Month (abbreviated) Year e.g.: 26 Sept. 2012
- A "Works Cited" page is always a SEPARATE page.
- It is not necessary to include the URL Address for webpages.