

Lab 2: Scientific Research: Bacterial Investigations

In this lab session students should complete the following:

- Complete Lab Quiz 1
- Complete the Scientific Literature Research Seminar presented by Mason Yang from Library and Learning Services
- Read the section entitled, “Disinfectants, Antiseptics, and Antibiotics – Friend or Foe?” found in this lab packet
- Read the supplemental material, “Disinfectant Overkill.”
- Design a research bacterial investigation project and complete the project proposal.
- Discuss the research proposal with the instructor for approval. Students can **ONLY** carryout their scientific investigation once approved by the instructor. **No two groups are allowed to complete the same exact experiment**
- Carry out student designed experiment.
- Listen to Instructor’s discussion of your scientific research semester project criteria.
- Return all lab materials to work station, wipe down work area, and push in chair

Homework

- After reviewing the instructor’s comments on their first lab report, students have the option to Revise their first lab reports and submit the reports for regarding. This is the only time in the semester where students will be allowed to resubmit a lab report for regarding.
- Students should prepare for their upcoming laboratory quiz and for the next lab session’s exercise activity.

Disinfectants, Antiseptics, and Antibiotics: Friend or Foe?

Introduction

Microorganisms include microscopic life forms like bacteria, fungi, and viruses (although viruses are considered non-living microbes). Because of their microscopic nature, microorganisms are typically ubiquitous. This means they can live in pretty much any type of environment there is. Microorganisms reside on and in your body, in the air, and on everything that you touch. Some microbes are not harmful to humans. We refer to these types of microbes as **non-pathogenic**. Non-pathogenic microorganisms include organisms like yeast. We interact with microorganisms each and every day. In fact, many are responsible for the development of certain foods. For example we use yeast to make bread, wine, and beer for consumption. Many microorganisms are also responsible for helping in providing nutrients to plants to ensure plant growth. Some microorganisms do this by breaking down large organic compounds such as rotting wood.

Although there are number of microorganisms which do not induce disease in humans, there are a number of microorganisms which do. These microorganisms are said to be **pathogenic**, because they can cause illness and harm to humans and in some instances other animals. Pathogenic microorganisms induce infection and disease. Examples of some infectious disease caused by pathogenic microorganisms include Staph infection, meningitis, chlamydia, food poisoning, and strep throat. Although fungi and viruses cause infection and disease, bacterial organisms tend to cause more disease and infection in humans. In order to combat infection, we rely on the use of **antibiotics** and **disinfectants** to control bacterial growth or to eradicate bacteria. The primary difference between an antibiotic and a disinfectant is that antibiotics are medicinal products which humans use to control infection in the body. Examples of antibiotics include penicillin, erythromycin, tetracycline, ampicillin, etc. Antibiotics can be taken orally by an infected patient or intravenously. They are biosynthesized products administered internally to disrupt pathogenic growth. Disinfectants are products used to prevent the spread of bacteria and other microorganisms from one human to the next. We use disinfectants to clean wounded breaches in the skin, clean table surfaces and floors, and to clean soiled clothing. Examples include Lysol, toilet scrub, and Clorox. Some disinfectants such as chlorine can cause skin irritation, so specialized disinfectants have been developed for the safe use on humans. Disinfectants which are safe for humans to use on their skin are referred to as **antiseptics**. Examples include mouthwash, anti-bacterial soap, hydrogen peroxide, and 70% rubbing alcohol.

In this investigation, students will design an experiment involving bacteria. After reading the information on bacteria provided, students should decide what aspects of bacteria, antibiotics, and disinfectants is worthy of investigating. For instance, some companies hire scientists to test the effectiveness of their product in killing bacteria before the product is put on the market. Some companies hire scientists to collect samples of meats from different food companies to see what types of bacteria maybe growing on the food after the food has been put on the market. For this lab, the students will need to plan their experiment and carry out the experiment in the lab. Below is a list of materials available for students use. Following the materials list is an example protocol, students may use in their investigation.

Materials

1. Bacterial broth cultures of
 - o *Escherichia coli*: Gram-negative rod commonly found in human fecal material
 - o *Serratia marcescens*: Gram-negative rod shaped bacteria, ubiquitous in the environment
2. Different Disinfectants
3. Different Antiseptics
4. Different Antibiotics
5. Nutrient Agar Plates
6. Sterile Swabs
7. Sterile discs

Investigation Question and Purpose of Experiment:

Hypothesis:

Methods & Materials Needed (Describe how this experiment will be set up.):

E. coli mouth wash p/cobol Hydrogen.

Identify the following variables: Dependent variables, Independent variables, and Control variables.

Data Collection

1. Observe the plates. If the experiment was successful students will see bacterial growth all over the plate. However, there should not be bacteria growing around the disc applied to the plate. To determine if the product being tested was effective in preventing the bacteria from growing, students will observe a clear ring around the disc. This clear ring can be very large or kind of small. This clear ring is known as the **Zone of Inhibition**. This is the zone in which the disinfectant, antiseptic, or antibiotic has successfully inhibited or prevented the growth of the bacteria on the agar plate. If a product produces a big zone that means that the product is very effective in preventing the growth of the bacteria. To determine if the product is effective, students must measure the diameter of the Zone of Inhibition. To do this, students will measure the diameter of the disc used and subtract this diameter from the diameter of the clear zone surrounding the disc. The difference between the two diameters will equal the diameter of the Zone of Inhibition.

$$\text{Zone of Inhibition} = \text{Total Diameter (mm)} - \text{disc diameter (mm)}$$

Table 1: Zone of Inhibition (mm) for each Plate Quadrant

Quadrant	I	II	III	IV
Compound Applied	ALCOHOL	MOUTH WASH	Hydrogen Peroxide	Water
Plate 1	29 mm	29 mm 4 mm	29 mm	0 mm
Plate 2	29 mm	14 mm	29 mm	0 mm
Plate 3	29 mm	9 mm	29 mm	0 mm
Average	29 mm	14 mm 7.3 mm	29 mm	0 mm

Interpreting Results

1. Using your calculated average quadrant zone of inhibition (mm), categorize the outcome for each compound.

Bacteria is Susceptible ^{resistant} to product	≤ 10 mm
Bacteria is somewhat susceptible to the product Intermediate	11 – 15 mm
The Bacteria tested is susceptible ^{resistant} to the product tested	≥ 16 mm

Quadrant I = Susceptible

Quadrant II = resistant

Quadrant III = susceptible

Quadrant IV = resistant

a. What do the results suggest?

b. What is the overall conclusion?

c. What questions does this stimulate? What topics should students research to help answer these questions?

Semester Research Project Lab Report (50 Points)

After collecting the group's experiment data, each student in the group will draft their own individual laboratory research report using the Semester Research Project Lab Report criteria provided by the instructor. This lab report is different from the other lab reports students will be writing throughout the semester. The criteria for this report is found in the document entitled, "Semester Project Assignment: Individual Lab Report" located at the end of this packet. The document is also posted in Blackboard and the instructor will review the Semester Project information with the class.

★ PAGE 131★

Semester Research Project: Individual Lab Report

Title Page & Format (1point)

- _____ / 0.5 pt The title page should contain a clear and concise scientific title.
Example: *An Investigation into the Effects of Caffeine on Worms*. Also include: student name, group members, instructor name, section letter, and date
- _____ / 0.5 pt Format lab report using 1 inch margins, 12 point font, double space, and appropriate headings for each section of the lab report. Write lab report using the third person narrative. Do not use terms such as, "I", "us", or "we".

Introduction (11 points)

- _____ / 5pt Students should provide relevant background information which introduces the reader to important elements of the investigation. Students should define important terms and provide all sources from which the information comes.
- _____ / 3 pt Explain why the investigation is taking place. Why is the question being investigate? What makes it important? What is the objective of the study?
- _____ / 3pt State and explain your hypothesis. What do you think will happen and explain using relevant background why you think your hypothesis will be proven correct.

Methods (6 point)

- _____ / 6 pt In paragraph form, summarize the protocol used to carry out the investigation. Describe the methods used and the overall design of the investigation. State the materials involved, but do not list them.

Results (8 point)

- _____ / 4 pt Describe the data collected and compile the data into the appropriate table, chart, or graph depending on the type of data collected from the investigation. Make sure that every figure (table, chart, graph, or picture) included in the results has a proper title and caption explaining the figure.
- _____ / 4 pt In paragraph form, provide a descriptive summary of the results referring to the figures you provided in this section.

Discussion (12 points)

- ____ / 2 pt Briefly state the purpose of the investigation, and briefly summarize the results of the experiment.
- ____ / 6 pt In great detail, describe what the results indicate about your investigation. Does the data reveal an interesting trend? What is that trend? Provide one or several explanations as to why the trend observed occurred?
- ____ / 4 pts What makes the trend your data reveals important? How can you use the data you've collected to solve a major need in society, industry, or the environment? Example: If you conducted an experiment on growing flowers and your data showed flowers would not grow in soil containing old automobile oil, how could this data be useful to our everyday lives?

Works Cited (4 point)

- ____ / 2 pt Are at least 2 primary sources listed in the Works Cited Section of the lab report? Are at least 1 secondary source listed in the Works Cited Section of the lab report?
- ____ / 2 pt Are all sources listed cited within the Introduction Section or the Discussion Section of the lab report?

Demonstrates understanding of concepts (8 points)

- ____ / 8 pts How well does the student understand the concepts involved in the experiment? Is it clear that the student followed the scientific method?

Total

____ / 50 pts

Honor Code Pledge

"On my honor, I have neither given nor received aid on this assignment."

Printed Name

Signature

Date

Students must sign the Honor Code Pledge before handing in assignment. Lab reports submitted to the instructor without an Honor Code signed by the student will not be graded.

Semester Research Project Presentation Rubric
Due the last day of Class

	5 points	6 points	8 points	10 points	Total
Organization	Audience cannot understand presentation because there is no sequence of information	Audience has difficulty following presentation because student jumps around.	Student presents information in logical sequence which audience can follow.	Student presents information in logical, interesting sequence which audience can follow.	
Subject Knowledge	Student does not have grasp of information; student cannot answer questions about subject	Student is uncomfortable with information and is able to answer only rudimentary questions	Student is at ease with expected answers to all questions, but fails to elaborate	Student demonstrates full knowledge (more than required) by answering all class questions with explanations and elaboration	
Graphics	Student uses superfluous graphics or no graphics	Student occasionally uses graphics that rarely support text and presentation	Student's graphics relate to text and presentation	Student's graphics explain and reinforce screen text and presentation	
Mechanics	Student's presentation has four or more spelling errors and/or graphical errors	Presentation has three misspellings and/or grammatical errors	Presentation has no more than two misspellings and/or grammatical errors	Presentation has no misspellings or grammatical errors	
	2 points	3 points	4 points	5 points	Total
Eye Contact	Student reads all of report with no eye contact	Student occasionally uses eye contact, but still reads most of report	Student maintains eye contact most of the time, but frequently returns to notes.	Student maintains eye contact with audience, seldom returning to notes	
Elocution and	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation.	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation.	
Total Points (Possible = 50 points)					