University of Rochester
School of Nursing

NSG 315: Microbiology Lab for the Health Sciences

Pre-Requisite(s)
Prior or concurrent didactic microbiology course is recommended.

Co-Requisite(s)
Prior or concurrent didactic microbiology course is recommended.

Credit Hours
Lab hrs: 1 credit = 2 clock hrs/week (28 hrs/semester)

Course Format
Complete Online Course

Meeting Days, Times, and Locations
Fully online. No required in-class sessions. See course outline for anticipated time of completion. Students should plan on a minimum of four weeks to complete this course.

Course Description
This course is designed as a stand-alone lab that can be taken concurrently with any microbiology course such as Microbiology and Application to Health (NSG 309). Learners will study microscopic organisms that range from observing eukaryotic and prokaryotic cell structure to understanding microbial genetics. This distance learning lab provides learners with the knowledge and skills necessary to conduct laboratory experiments, observe and analyze results, and complete laboratory reports in the home setting. Open to nonmatriculated students.

Student Learning Outcomes
At the conclusion of this course, the student will achieve the following identified outcomes:

1. Describe various types of microorganisms
2. Conduct lab experiments using proper technique
3. Quantify the number of microorganisms in a given sample
4. Explain the techniques used to control microbial growth
5. Analyze how different types of media can be used to grow specific microorganisms
6. Examine how various nutrient sources and ecological factors impact microbial growth

Teaching Methods/Activities
This course uses a combination of methods to facilitate learning and mastery of content, including:

- Safety guidelines
- Virtual presentations
- Instructional videos
- Case studies
- Recommended websites
- Practice questions
- Digital Lab Manual
- Hands-on experiments conducted in the student's home setting
- Observation and analysis of laboratory results
- Laboratory reports
- Customer support and service

Evaluation Methods/Learning Outcomes

Course Requirement	Percent of Total Grade	Alignment with Student Learning Outcome(s)

1. Completion of Laboratory Experiments (Evidenced by Lab Photo upload)	40%	SLO 1-6
2. Laboratory Manuals	40%	SLO 1-6
3. Practice Quizzes	20%	SLO 1, 3, 4, 5, 6

The final grade entered is based on School of Nursing grading system. See *Student Handbook* (https://www.son.rochester.edu/assets/pdf/studenthandbook.pdf)

This course is entirely online, so the only way course faculty have to contact you is through the email you used to sign up for this course. You should be checking your email at least 3-4 times per week in case course faculty are trying to contact you. This is extremely important. Please feel free to contact course faculty with any questions.

Grading System

The student's final numerical grade will be converted to a letter grade based on the following University of Rochester undergraduate student grading criteria:

A	93-100	**C**	73-76	
A-	90-92	**C-**	70-72	"C-" is considered unsatisfactory work for undergraduate students; see *Student Handbook* for implications.
B+	87-89	**D+**	67-69	
B	83-86	**D**	63-66	
B-	80-82	**D-**	60-62	
C+	77-79	**E**	<60	Failing grade; see *Student Handbook* for implications.

For both UG and graduate programs: Grades will be rounded up so that 0.5 (and above) rounds to the next whole number (e.g., a grade of 72.5 will round up to a 73; rounding is only to the tenths; for example, 72.47 does not round up to a 72.5).

The Center for Lifelong Learning wants to make sure you have the time you need to do your best work in this course. It is your responsibility to reach out to course faculty to ask for more time if you need it, and to sign the contract that is sent to you and return it before the end of the semester. Failure to do so will result in zero points posted for any outstanding work and a final grade being calculated and posted.

Required Textbook(s)

eScience Labs, Microbiology 2nd Edition Lab Kit

Required Equipment:

Students will be required to take photographs and/or videos of each lab set-up and upload them to Blackboard. Additional household materials (e.g., bleach, food, measuring cups/spoons) to use throughout the experiments as outlined on the eScience Labs website found here: https://esciencelabs.com/student

Course Outline

Lab Topic	Lab #	Approximate Time to Complete
Introduction to Science	1	2 hours
Microbiology Lab Safety	2	Preparation: 30 minutes Observation and Analysis: 2-3 days
Introduction to the Microscope	3	1 hour
Introduction to Culturing and Aseptic Technique	4	Preparation: 60 minutes Observation and Analysis: 6 days
Structure and Microscopy	5	Preparation: 90 minutes Observation and Analysis: 3 days
Growth of Microorganisms	6	Preparation: 60-90 minutes Observation and analysis: 4-6 days
Quantitation of Cultured Microorganisms	7	Preparation: 60-90 minutes Observation and Analysis: 2-3 days
Selective Media and Agar	8	Preparation: 3-4 hours Observation and Analysis: 1-2 weeks
Differential and Biochemical Tests	9	Preparation: 5 hours Observation and Analysis: 4-6 days
Eukaryotic Microbes, Parasitology, and Viruses	10	Preparation: 2 hours Observation and Analysis: 2 weeks
Food Microbiology	11	Preparation: 60-90 minutes Observation and Analysis: 28 hours
Microbial Genetics and Genetic Engineering	13	30 minutes

ADA Statement and Holidays
See *Student Handbook* (https://www.son.rochester.edu/assets/pdf/studenthandbook.pdf)

Academic Honesty Statement
Students are responsible for their own work. Students are expected to have read and to practice principles of academic honesty. See *Student Handbook* (https://www.son.rochester.edu/assets/pdf/studenthandbook.pdf) Student attestation is completed on Blackboard for each course.

Professional Behavior/Civility Statement
The University of Rochester, School of Nursing (SON) seeks to provide an environment for learning and teaching that is respectful of diverse persons and points of view in all classroom, electronic, and clinical settings. Consistent with this goal, it is expected that diverse perspectives and opinions will be expressed and received in a respectful and professional manner. Incivility, intolerance, hate speech, and abusive behaviors are considered professional misconduct and will be acted upon in accordance with the statement in the *Student Handbook*. (https://www.son.rochester.edu/assets/pdf/studenthandbook.pdf)

TITLE IX/Sexual Harassment Policy
All members of the University community have the right to learn and work in a safe environment free from all forms of harassment, including harassment on the basis of sex or gender. Students who have been subjected to sexual harassment, including sexual assault, dating/domestic violence or stalking, have the right to receive academic, housing, transportation or other accommodations, to receive counseling and health services and to make a report about such behavior to the University and to law enforcement. For more information please visit www.rochester.edu/sexualmisconduct.

HIPAA Compliance

Students are to abide by the University of Rochester HIPAA Compliance Guidelines which can be found on the SON website (http://son.rochester.edu/r/HIPAA-Video).

Module	Topic in Course	Module Activities	Lab SLO's	Lab Experiments	Length of time to complete
Intro Module		Overview of the Learning Management System Demonstrate use of tools in the LMS Describe Course requirements	1. Describe the steps of the scientific Method (SLO 2) 2. Differentiate among independent variables, dependent variables, and controls in a scientific experiment (SLO 2) 3. Design an experiment with experimental and control groups (SLO 2) 4. Perform calculations to convert units and determine percent error(SLO 2) 5. Describe components of a lab report (SLO 2)	**Lab #1: Introduction to Science** <u>Experiment 1: Design an Experiment</u> Design an experiment to test selected variables that may (or may not) affect yeast fermentation. Practice writing a lab report	2 hours
LM #1	Introduction to Microbiology & Classification	Overview of Microbiology	1. Describe how to work safely in a microbiology lab (SLO 2) 2. Describe how and when to use safety equipment in a microbiology lab (SLO 2) 3. Safely perform a common microbiology lab experiment (SLO 2)	**Lab #2: Microbiology Lab Safety** <u>Experiment 1: Importance of Hand Hygiene</u> - Practice aseptic technique and compare growth of microorganisms collected from unwashed vs. washed hands.	30 minutes Prep 2-3 Days for observation and analysis
LM #2	Microscopy	Virtual Microscope	1. Describe microscopes commonly used in microbiology labs. 2. Explain how to properly use a compound microscope (SLO 2) 3. Survey different methods of microscope slide preparation (SLO 2)	**Lab #3: Introduction to the Microscope** <u>Experiment 1: Virtual Microscope</u> - Utilize the VirtualUrchin virtual microscope to understand how to use a compound microscope, adjust to different magnifications, and view images from different types of microscopes	1 hour

			1. Identify the necessary nutrients for microbial growth media (SLO 6) 2. Define proper procedure for preparing culture plates (SLO 2) 3. Describe the different tools and proper technique for inoculating culture plates (SLO 2, 4)	**Lab #4: Culturing and Aseptic Technique** <u>Experiment 1: Agar Plate Preparation and Bacterial Inoculation</u> - Learn how to pour agar into a petri dish, collect microorganisms from the local environment, and culture samples on a growth plate. <u>Experiment 2: Bacterial Transfer to a Stab Tube and an Agar Plate</u> - Practice transferring isolated bacterial colonies using aseptic technique and analyze their results.	60 minutes prep 6 days for observation and analysis
LM #3	Prokaryotic Cell Structure & Function	Cells Alive-Bacterial Cell	1. Explain the difference between prokaryotic and eukaryotic cell structure. (SLO 1) 2. Describe the various cell shapes of prokaryotes. (SLO 1) 3. Differentiate staining techniques commonly used in microbiology (SLO 2)	**Lab #5: Structure and Microscopy** <u>Experiment 1: Staining</u> - Prepare six bacterial slides to use in three separate staining experiments. Two slides are used to practice simple staining technique and assess results with a microscope or view sample image on the eScience student portal if no microscope. <u>Experiment #2: Negative Staining</u> - Students use two of their prepared bacterial slides to practice negative staining technique and assess results with a microscope (if accessible) or view sample results on the eScience Labs Student Portal. Students also	90 minutes plus 3 days for observation and analysis

				begin to analyze the differences in results created from a simple stain vs. a negative stain. <u>Experiment #3: Gram Staining</u> - Students use their final two slides to perform the gram staining technique and assess results with a microscope (if accessible) or view sample image results on the Science Labs Student Portal. Students continue analysis of different staining methods.	
LM #4	Microbial Metabolism	Krebs Cycle and Electron Transport Chain	1. Explain the phases of microbial growth in culture (SLO 4) 2. Describe the difference in requirements for growth in a variety of microorganisms. (SLO 4) 3. Analyze methods to control the growth of microorganisms. (SLO 4)	**Lab #6: Growth of Microorganisms** <u>Experiment #1: Fluid Thioglycollate Medium (FTM) to Assess the Effect of Oxygen on Bacterial Growth</u> - Students use FTM to indicate oxygen presence and draw conclusions between oxygen presence and microbial growth. <u>Experiment #2: Effect of Chemical Germicides on Bacterial Growth</u> - Students use common liquid germicides to better understand inhibition of bacterial growth.	60-90 minutes prep Plus 4-6 days for observation and analysis.
LM #5	Microbial Growth	Cells Alive!- Microbial growth curves	1. Describe methods for quantifying microbial growth on culture plates (SLO 3) 2. Describe the process and purpose of performing a serial dilution.(SLO 3) 3. Explain additional methods of culturing plates with a countable	**Lab #7: Quantitation of Cultured Microorganisms** <u>Experiment #1: Direct Counts Following a Serial Dilution</u> - Perform a serial dilution and count the resulting CPUs (at different dilution values) to	60-90 minutes prep Plus 2-3 days for observation and analysis.

			number of colonies. (SLO 3) 4. Introduce plaque assays as a way of determining viral load. (SLO 3)	practice quantifying growth and learn about bacterial growth needs.	
LM #6	Microbial Genetics	Biology Tutorials	1. Describe the basic structure of DNA 2. Differentiate between transcription and translation 3. Identify different types of mutations that can occur 4. Describe recombinant DNA and its uses in the laboratory and industrial settings	**Lab # 13: Microbial Genetics and Genetic Engineering** <u>Experiment #1: DNA Extraction</u> - Use strawberries as a substitute for bacteria to extract DNA. <u>Experiment #2: Cloning a DNA Fragment to a Bacterially-Derived Plasmid Vector</u> - Students are provided with two sequences of DNA (one foreign gene sequence and one plasmid DNA sequence) and use an NCIB computer program to identify where the common restriction enzymes for both DNA sequences occur.	30 minutes
LM #7	Control of Microorganisms and Antimicrobial Drugs	Antimicrobial Susceptibility Microbes Strike Back	1. Explain the use of pH indicators in growth media (SLO 5) 2. Describe different types of metabolic, nutrient, and hydrolytic assays. (SLO 5,6) 3. Utilize the Kirby-Bauer disk diffusion method (SLO 4)	**Lab #9: Differential and Biochemical Tests** <u>Experiment #1: Oxidase Assay for Respiration</u> - Students experimentally determine if their cultured microbial samples contain cytochrome c oxidase through use of a DrySlide Oxidase Cassette <u>Experiment #2: Catalase Assay</u> - Students experimentally determine if their cultured microbial samples produce the catalase enzyme by adding	**5 hours** Plus 4-6 days of observation and analysis

				hydrogen peroxide to isolated colonies and looking for evidence of a reaction through the formation of bubbles. <u>Experiment #3: Antibiotic Sensitivity</u> - Students use the Kirby-Bauer disk diffusion test to study the effects of different antibacterial agents on microbial growth.	
LM #8	Principles of Disease and Epidemiology, Microbial Mechanisms of Pathogenicity	Tracking Epidemics Bacterial Meningitis	1. Describe the minimal nutrient requirements for culturing microorganisms.(SLO 6) 2. Describe the different types of growth media (SLO 5) 3. Survey practical uses for differential and selective media (SLO 5)	**Lab #8: Selective Media and Agar** <u>Experiment #1: Bioprospecting for Starch Degrading Bacteria</u> - Students use a succession of nutrient agar and starch media to select for starch degrading bacteria and examine the potential outcomes of selective media. <u>Experiment #2: Selection and Differentiation of Body Inhabiting Gram-Positive Bacteria</u> - Students collect bacteria from their body and investigate the use of Mannitol Salt Agar (MSA) as a selective and differential medium for Gram-Positive bacteria. Students also use the indicator dye phenol red to observe the relative pH of the afar surrounding the colonies <u>Experiment #3: Selection and Differentiation of Body Inhabiting Gram-Negative Bacteria from Liquid Samples</u>	3-4 hours prep plus **1-2 weeks** for observation

				- Students collect liquid samples and test them for the presence of coliform bacteria. This is done through the use of MacConkey agar to select for Gram-negative bacteria by inhibiting growth of Gram-positive bacteria.	
LM #9	Viruses, Anti-Viral Agents, and Microbial Diseases of the Skin and Eyes	Virology Summary Mad Cow Disease Shingles Vaccine	1. Survey common eukaryotic microorganisms (SLO 1) 2. Describe the properties and types of microscopic fungi and protozoa (SLO 1) 3. Explain the study of parasitic helminths in microbiology (SLO 1) 4. Describe acellular microbes such as viruses (SLO 1)	**Lab #10: Eukaryotic Microbes, Parasitology, and Viruses** <u>Experiment #1: mold Growth on Bread and Fruit- What are the Optimal Conditions for Fungal Growth?</u> - Students examine the effects of different environmental conditions on mold (filamentous fungi) growth on pieces of bread and apples to determine what factors encourage mold growth. <u>Experiment #2: Microscopic Observation of *Saccharomyces cerevisiae*</u> - Students culture yeast samples and prepare a microscope slide containing stained samples to view on a microscope (if accessible) or view examples online at the eScience Labs Student Portal.	2 hrs. plus **2 weeks** for observation and analysis.
LM #10	Microbial Disease of the Digestive, Urinary, and Reproductive Systems	Bad Bugs Zoonoses	1. Examine the use of microorganisms in making food through fermentation (SLO5. 6) 2. Describe the potential dangers of contamination of food by harmful microbes (SLO 4) 3. Explain the measures that are taken to prevent contamination	**Lab #11: Food Microbiology** <u>Experiment #1: Assess the Bacterial Load of Milk with Methylene Blue</u> - Students perform a time-course experiment to view the breakdown of the dye Methylene Blue in milk as an indicator of the	50-90 prep 25 hours observation and analysis

			of food by pathogens (SLO4)	presence of bacteria. <u>Experiment #2: Yogurt Preparation</u> - Students prepare a sample of homemade yogurt to understand the use of bacterial fermentation in certain dairy products.	

Note. SLO is an abbreviation for "student learning outcomes." The notation [SLO #] refers to course level student learning outcomes, and shows how each module objective aligns to the corresponding course level student learning outcome.