# Biology 102L – Introductory Biology Laboratory with Research: Microbial Interactions (Hunting for Microbes)

**Course description:** Even though microbes are small, they live everywhere. Although they usually live in mixed populations in the natural environment, it is possible to study them when they are separated from other species from within their habitat. Looking for these microbes can be done using aseptic pure culture techniques and microscopy. One motivation for isolating and studying these microbes in the lab is that humans use natural products produced by bacteria as therapeutic drugs, including antibiotics. In this course bacteria from the soil will be collected, isolated, and analyzed to attempt to discover new natural products they may produce. Students will be able to make their own predictions about how different soil treatments might affect bacteria. Additionally, some microbes identified by students will be further pursued by members of Dr. Elizabeth Shank's microbiology research lab here at UNC. In addition to gaining experience in the scientific process, this course will enhance the topics from Introductory Biology by teaching major microbiology techniques, introducing new scientific skills, and emphasizing the collaborative nature of an authentic research project.

| **Date** | **Experiment/Activity** | **Assignment Due Before Class** |
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| June 25 | 1) Microbe Physiology & Diversity – Why study microbes? Where are they found? Discuss as a class<br>2) View protists under microscope and compare to bacteria<br>3) Stain different bacteria to identify by shape and color using microscopy<br>4) Practice the sterile streak technique | Read Chapters 1 & 2 of Microbe Hunters (posted on Sakai)<br>Watch video tutorials of Gram Stain and Sterile Technique Procedures (links in Sakai), copy these protocols into your lab notebook<br>Read Microscopy Handout (posted on Sakai) |
| June 26 | 1) Group Presentations of historical figures in microbiology with peer feedback<br>2) Each group discusses a section of the assigned scientific paper in class<br>3) Observe previously streaked plates for growth and examine under microscope, record results in your lab notebook including pictures<br>4) Identify the bacteria | Read article on soil microbes (link posted in Sakai)<br><br>Read about sections of a scientific paper (link posted in Sakai) |
| June 28 | 1) Quiz on material from previous two labs<br>2) Plate streak practice using bacterial stock plates<br>3) Do serial dilutions (dilute known bacterial stock and plate, refrigerate for a week and then count) | Prepare for Quiz<br><br>Read information about performing serial dilutions (posted on Sakai) |

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| | 4) Special talk by Dr. Elizabeth Shank<br>5) Make predictions about treatments and possible effects on bacteria<br>6) Groups come up with treatment experiment then each will use own soil | |
| July 2 | 1) Lab notebooks will be collected<br>2) Count serial dilution plates from July 2<br>3) Bring in soil, treat<br>4) Make cfu dilutions of treated soil and then freeze as aliquots<br>5) Learn how to streak from frozen stocks<br><br>July 5 TA puts plates in fridge | Work on lab report from experiment done on July 2 (Outline of lab report format on Sakai)<br><br>Record planned experiment for treating soil including protocols, reagents, descriptions… in lab notebook |
| July 2 | TA preps co-culture plates as positive control for fluorescence picking practice | |
| July 3 | 1) Lab reports due<br>2) Determine cfu/ml from frozen aliquot serial dilutions<br>3) Pick and streak practice (take pictures before and after picking)<br>4) Learn how to use fluorescence microscope<br>5) Pick and streak practice using fluorescence microscope<br>6) Make practice co-culture plates by mixing soil and provided reporter, as well as setting up unmixed controls. Practice getting 1:1 ratio.<br><br>July 9 TA puts practice co-culture plates in fridge | Read protocol for setting up screen plates (link on Sakai)<br><br>Be prepared to begin co-culture screen experiment |
| July 5 | 1) Revise lab reports<br>2) Look at practice co-culture plates and adjust concentrations if necessary<br>3) Replate mixed co-cultures and unmixed control plates for picking tomorrow during lab<br><br>TA generates 'contaminated' practice hit plates for students to practice re-streaking of their hits | |
| July 9 | 1) Lab report due<br>2) Examine co-culture plates; practice picking colonies fluorescence induction with TA from control plates | |

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| | 3) Identify inducing soil organisms on co-culture plates by observing fluorescence using dissecting scopes<br>4) Select possible inducing microbes and streak onto plates (at least 5 potential hits from each condition, more if desired, ideally diversifying morphology of hits)<br>5) Practice using dissecting scope to differentiate contamination in struck hits<br>6) Record ideas and experimental procedure in Lab notebook | |
| July 10 | 1) Re-streak all hits two more times onto fresh plates; use dissecting scope to be sure purifying | |
| July 12 | 1) Examine co-culture plates<br>2) Practice picking colonies from control plates<br>3) Identify organisms, select inducing microbes and streak | |
| July 16 | 1) Re-streak all hits two more times using stereoscope | |
| July 17 | 1) Midterm<br>2) Make frozen stocks of hits from first round of co-culture | Read about 16S identification and bacterial phylogeny |
| July 19 | 1) Streak possible hits from freezer | |
| July 23 | 1) Get new reporters and set up co-culture screen<br>2) Set up PCR from hits | Read about BLAST (link on Sakai) |
| July 24 | 1) Come in to record results of second screen | Need laptops for DNA analysis |
| July 26 | 1) Plate new cultures with new reporters<br>2) Check lab notebooks<br>3) Discuss how to put a poster together | |
| July 30 | Poster presentations | |

**Lab Meetings:** Monday, Tuesday, Thursday

**Outside of Lab Meetings:** Some weeks require you to come in and count bacterial colonies on plates, make calculations from your data, streak pure cultures or frozen stocks, or prepare plates in advance of class (these 'off-class' obligations are noted in red above).

**Instructors:** Barbara Stegenga, Coker 211, bstegenga@bio.unc.edu

Dr. Elizabeth Shank, GSB 4157, eshank@unc.edu

**TA:** Daniel Winecoff

**Sakai site:** The syllabus, assigned reading, schedule, links to videos and announcements will be on the Sakai site. Please check this site regularly.

**Credit hours:** 1

**Meeting times:** 9 hours per week; 12:00-3:00pm

**Co-requisite:** BIOL101

**Room:** Coker 207

**Text:** There is no required text for this course. Assigned readings will come from primary literature, a book and news and will be posted on Sakai.

**Lab Exercises:** Assignments related to the readings and your research will be collected in class. In-lab assignments and quizzes will be given. You will receive 5 points for participating each week in discussions and lab work in addition to keeping a lab notebook.

**Mid-term:** One exam for the course will focus on the assigned readings, PowerPoint slides, homework, learning outcomes, quizzes, lab reports, and in-class assignments. Test materials to study: lab notebook, lab exercises, reading, slides, and learning outcomes.

**Presentation:** The presentation will replace a final exam. You will present your findings to the rest of the class which includes a poster presentation.

**Items to bring to class each week:** Lab notebook, computer, writing utensils, creativity

**Grading:** Total for the semester= (0.125 x lab exercises, lab reports, quizzes) + (0.125 x class participation, group contributions) + (0.25 x midterm) + (0.50 x presentation)

The final exam will be replaced by the presentation the last week of the lab.

| **Grade Scale:** | | 87-89 | B+ | 77-79 | C+ | 67-69 | D+ |
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| 93-100 | A | 83-86 | B | 73-76 | C | 60-66 | D |
| 90-92 | A- | 80-82 | B- | 70-72 | C- | <60 | F |

Final grades will be assigned on the total number of points at the end of the semester.

***Course Goals:*** The lecture and the reading material will provide the basic content. You will develop skills in microbiology and molecular biology, learn how to formulate testable hypotheses, and design experiments to test them. You will read scientific literature and learn to take notes and write like a scientist.

***Doing the Science*** will allow you to acquire basic laboratory techniques and skills needed to identify and screen for microbes. You will hopefully discover new small molecules secreted from soil microorganisms through co-culture screening. PCR and DNA sequencing will be performed to determine the species identity if time permits.

***Sharing the science*** involves writing about your findings and giving a talk with your lab partners to the class and members of the scientific community about your science.

***Understanding and communicating the relevance of the science*** includes reading and discussing articles on interactions within species of microorganisms and understanding how these interactions relate to human health.

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