

# The Microbiome in Ecology

ZOO4926/ZOO6927

## **Class Periods:**

- Tuesday, Period 3 (10:35 AM – 11:30 PM)
- Thursday, Period 3 – 4 (9:35 AM – 11:30 AM)

**Location:** CARR Hall 521

**Academic Term:** Fall 2024

**Instructor:** Christopher Dutton

**Research Areas:** Microbiomes, low-cost open source technologies, environmental monitoring, aquatic ecosystem ecology, biogeochemistry, microbial community dynamics, conservation

**Email:** [duttonc@ufl.edu](mailto:duttonc@ufl.edu) (please contact me through Canvas for course related emails)

**Office Hours:** Anytime, by appointment (typically within a few hours of notice)

**Office:** CARR Hall 510

**Course Website:** Canvas (<https://elearning.ufl.edu/>)

## **Course Description**

One of the best ways to learn is by doing it. We will learn about the ecological principles of microbiomes by conducting a study of the microbiomes of captive Zoo animals of conservation concern. The course will begin with several weeks of lectures, discussions, videos, and literature review (Section 1). During Section 2, we will spend time learning about sample collection, extraction, sequencing, and bioinformatic methods for analyzing microbiomes. During the last section of the course (Section 3), we will work on the group projects with Zoo Keepers to identify interesting questions related to captive animal microbiomes. If a student has their own samples and their own question/hypotheses, I'm happy to facilitate them to work on their own samples for the course project. We will then extract DNA, prepare sequencing libraries, then sequence the samples to reconstruct the microbiomes of the animals and their immediate environment. This course will involve the use of HiPerGator and the R statistical programming language. The final project of the course will be a full workflow documented in R markdown and a brief presentation to the Zoo staff. **The overarching goal of this course is to inspire you and to have fun exploring the ecology of microbiomes.** 3 Credit Hours.

## **Course Objectives**

These are my top 5 course objectives. We'll approach each of these objectives through readings, lectures, discussions, and hands-on practice.

1. **Understanding Microbiomes:** Gain a foundational understanding of what microbiomes are, including their composition, diversity, and functions in different animal species and in the environment.
2. **Ecological Interactions underpinning microbiome science:** Explore how the mixing of entire communities contributes to changes in community composition and function using metacommunity theory and community coalescence.
3. **Impact on Health and Disease:** Investigate how microbiomes influence animal health, including their role in disease resistance, digestion, and nutrient absorption, and how disruptions in microbiomes can lead to health issues.

4. Methodologies in Microbiome Research: Learn about the techniques and methodologies used in microbiome research, such as automation with robots, DNA sequencing and computational biology.

5. Hands-On Experience: Provide practical experience through laboratory work and research projects to apply theoretical knowledge to real-world situations.

### **Format**

- This course is not your typical course. I have structured it to be interactive and fun. We will learn about microbiomes, by actually working with Zoo keepers to investigate several current mysteries involving their animals. With that said, if you already have samples and a question, I'm happy to facilitate you to do your class project using your own samples.
- There will be a final project and class presentation for each group. This will involve:
  1. Developing a hypothesis in related to a captive animal of conservation concern,
  2. Collect samples, extract DNA and do quality control,
  3. Sequence DNA on a Nanopore Minion,
  4. Analyze data using R,
  5. Give a short presentation to the class and Zoo staff on your project.

### **Course Pre-Requisites / Co-Requisites**

None. No prior knowledge necessary.

### **Materials and Supply Fees**

None! I've worked hard to make this course cheap and accessible.

### **Required Textbooks and Software**

There are no required textbooks for this course. We will be reading papers from the scientific literature that are freely available. I will also provide a list of recommended readings for those who would like to get more in-depth knowledge on specific topics. It is recommended that each person in this course brings a laptop computer with them during each class. At a minimum, each group will need a laptop computer during class. We will be using the following FREE software packages during this class:

- R Programming Language
  - <https://cran.r-project.org/>
- R Studio
  - <https://rstudio.com/>

### **Recommended Materials**

Recommended readings, videos and material will be posted on the Canvas site.

### **How to do well in this course?**

Show up and actively participate in your group. Ask questions when you don't understand something. There are no dumb questions! Reach out to me early for any problems, issues, or questions.

### **Course Schedule**

This is a preliminary outline of the course schedule. The course will evolve throughout the 15 weeks depending on how the investigation proceeds.

## Section 1: Introduction to Microbiome Ecology

### Week 1:

Thursday, August 22: Course Introduction, including Project Introduction

### Week 2:

Tuesday, August 27: Ecology Primer

Thursday, August 29: Ecological Principles of Microbiomes

### Week 3:

Tuesday, September 3: Important research questions in microbial ecology

Thursday, September 5: Environmental microbiomes

### Week 4:

Tuesday, September 10: Animal microbiomes

Tuesday, September 12: Pitfalls

## Section 2: Methods

### Week 5: Sample Collection and Automation Intro

Tuesday, September 17: Field Collection and Extractions

Thursday, September 19: Automation with Opentrons Flex

### Week 6: Sequencing and Bioinformatics

Tuesday, September 24: Sequencing Technologies

Thursday, September 26: R and R Markdown

### Week 7: Bioinformatics

Tuesday, October 1: Phyloseq

Thursday, October 3: Microeco

## Section 3: Projects

### Week 8: Automated Extractions

Tuesday, October 8: Extractions

Thursday, October 10: Extractions

### Week 9: Automated Extractions

Tuesday, October 15: Extractions

Thursday, October 17: Extractions

### Week 10: Library Preparation and Sequencing

Tuesday October 22: Sequencing

Thursday, October 24: Sequencing

### Week 11: Library Preparation and Sequencing

Tuesday, October 29: Sequencing

Thursday, October 31: Sequencing

### Week 12: Group Work

Tuesday, November 5:

Thursday, November 7:

### Week 13: Group Work

Tuesday, November 12:

Thursday, November 14:

### Week 14: Project Presentations!

Tuesday, November 19:

Thursday, November 21:  
 Week 15: UF HOLIDAY  
 Week 16:  
 Tuesday, December 3: Course Wrap-up

**Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance and participation are mandatory and will be a large part of your final grade. Due to the fast-paced nature of this course, it is very important to attend all classes. Of course, I understand that things come up and that’s OK too. You will need to meet with me as soon as possible after a missed class so that I can bring you up to speed with what you missed. If you know that you will miss a class, please notify me ahead of time so that we can plan to make it up. Excused absences must be consistent with university policies and require appropriate documentation. Additional information can be found here: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

**Evaluation of Grades**

Assignment	Total Points	Percentage of Final Grade
Attendance	60	60%
Final Project	30	30%
Presentation	10	10%
TOTAL:		100%

**Grading Policy**

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:  
<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

**Students Requiring Accommodations**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **Course Evaluation**

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://gatorevals.aa.ufl.edu/>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://gatorevals.aa.ufl.edu/>.

### **University Honesty Policy**

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### **Software Use**

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### **Student Privacy**

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

### **Campus Resources:**

#### Health and Wellness

#### **U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling.  
<https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus**: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints**: <http://www.distance.ufl.edu/student-complaint-process>.