

# **Biology 596: Ecological metagenomics**

Times TBA and locations

## **Class Syllabus**

<b><u>Instructor:</u></b>	<b><u>Office, phone</u></b>	<b><u>Email</u></b>	<b><u>Office hours</u></b>
Dr. Elizabeth Dinsdale	LS 308, 594-5623	dinsdale@sciences.sdsu.edu	TBA

### **Course Goals**

Ecological studies of microbes have traditionally been hindered with technical limitations on identifying community members and determining their metabolic and ecological roles in the community. Ecological metagenomics focuses on training students in next generation DNA sequencing technology to describe the ecological roles of microbial communities in different environments. Student-generated data will include a description of how the metabolic functions, taxonomic distribution, diversity, evenness and species richness of microbial communities varies across environments. The microbial communities that can be analyzed with these methods can be natural or experimentally manipulated, including those that have not been studied previously. For example, students may describe how the functions of the microbial communities associated with kelp forests change with increases in carbon dioxide, or whether the microbial taxonomic composition on sea urchins is unique or reflects sea water microbes from the environment in which the sea urchins live.

### **Learning Outcomes:**

Students will:

1. use metagenomic data to describe the taxonomic make-up, functional potential and ecological processes of microbial communities from a range of environments
2. apply next generation sequencing technology to ecologically relevant projects
3. assemble and annotate genomes by identifying genes and describing what each gene does
4. record data in a lab book and use these data to troubleshoot the DNA extraction process
5. extract DNA and analyze its quality
6. prepare DNA libraries
7. conduct an emulsion PCR, and sequence the libraries on a 454 pyrosequencing machine

### **Texts**

Written material for this course is made up of primary literature and manufacturers' protocols, which are available on the SDSU Blackboard website for this course.

### **Prerequisites**

Credit or concurrent registration in both BIOL 354 and BIOL 366 are required. Students that are enrolled for the course but do not have the appropriate prerequisites will be dropped by the instructor.

### **Adds/drops**

Crashers will only be considered if the course is not full. After the first three weeks of the semester (exact date is in the class schedule handbook) it is very difficult to drop any course at SDSU. All requests after that date are reviewed by the University's Registrar's office or an Assistant Dean, not

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by the instructors of the course. Please see your department's academic advisor if you have serious problems requiring withdrawing from your courses.

### **Class conduct**

Students are expected to be ON TIME and PREPARED for lecture and laboratories. The use of cell phones in any way (including text messaging) is distracting to other students and the instructor. TURN OFF CELL PHONES prior to lecture. The use of all electronic devices except calculators is strictly prohibited during quizzes. This includes cell phones and PDAs. Put a calculator in your backpack and leave it there, so you will have it for quizzes.

### **Class web site**

All class material will be posted on Blackboard (<https://blackboard.sdsu.edu>). This will include outlines, protocols, some primary literature, and grades. The web site is likely to be updated at least weekly.

### **Grading summary**

Participation – 5%

Quizzes– 20%

Lab book and practical tasks – 40%

Mid-term presentation – 15%

Final report – 20%

Standard grade distributions will apply: 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, <60% = F. Students receiving less than 60 % of the total points will still be given a grade of F for the semester in all cases.

**Participation:** Students are required to attend class each week and be prepared to conduct the experiments when they arrive. Active participation throughout the course is required to receive full credit, in terms of asking questions, troubleshooting procedures, and aiding others in the research group.

**Quizzes:** A brief quiz that covers preparation for the daily lab exercise will be given at the start of class, during random classes throughout the semester.

**Lab Book:** The course objective is to describe the ecology of an entire microbial population, which will only work if the students can achieve a sequencing run. Because problems are likely to be encountered during the process, students will keep a lab book with clearly described protocol to aid in troubleshooting. The lab book will be handed in three times during the course, after week 3, 7 and 12. The lab book is a working document for the students to describe the steps they have taken and observations they have made throughout the process. Therefore, the most important criteria of the lab book is that it contains a complete and accurate account of the process. Grammar and spelling are secondary considerations for the lab book (but not absent). To conduct any research records have to be accurately kept and information in the lab book will be drawn upon by the students in their presentations and report. Practical tasks include bioanalyzer score, bead retention etc.

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**Presentations:** Results will be presented in an oral format at mid points of the course. Oral presentations will be conducted with the aid of PowerPoint or a similar computer program. These presentations will be 10 minutes long, consisting of a 7 min talk and 3 minutes of question time. The talk will include a description of the type of microbial community, the ecological relevance, how the microbes were obtained, and some preliminary results about the DNA extraction and library construction process. Any problem encountered during the process should be discussed in the presentation. By presenting the data students can quickly see how their metagenome/genome varies to others in the class, enabling a discussion of how microbial communities vary with environmental parameters.

**Written Report:** The final written report is a formal discussion of the sequenced genome or metagenomes. The body of the report should identify genes which are present and those which are missing, and discuss the ecological relevance of this variation. It should also describe how the metabolic function, taxonomic distribution, and diversity change with environment parameters or experimental manipulation, and how changes in the microbial community may affect the ecology of the ecosystem by comparing metagenomes/genomes collected from different environments. The final report will emulate a scientific paper in journal format, requiring abstract, introductions, methods, results and discussion. The report will be marked on content and presentation including, spelling, grammar, and correct referencing.

### **Make up for illness**

This is a lab orientated course. Missing large sections of the course will result in students having difficulty completing the work. Make-up assignments may be given at the instructor's discretion. If students are going to miss a class:

1. Prior notice must be given to the instructor if at all possible.
2. If last-minute severe illness or exceptional personal problems prevent a student from presenting results, the instructor should be notified by email (preferable) or phone as soon as possible, and definitely before class. Documentation will be requested.
3. Consideration will not be given for traffic delays, work-related conflicts or personal out-of-town travel.
4. Unavoidable conflicts with major sporting events for student-athletes, or academic activities should be kept to a minimum and documented by the appropriate university office. Documentation should be presented to the instructor during the first two weeks of class.

### **Posting grades**

All grades will be posted on the Blackboard web site as soon as they are available. University rules prohibit grades to be emailed to students or posted in hallways.

### **Class requirements**

**Calculators:** Calculators may be required for calculations during laboratory exercises, but you must use only your own. Read the following carefully:

1. Bring your own calculator every time. You may not borrow a calculator from another student during quizzes. Only simple calculators can be used during quizzes (i.e., those without memory).

**Lab books:** Students need to have a bound lab book (spiral is ok). 9 3/4 by 7 1/2 inches preferred.

**Permanent marker pen:** Students need a permanent marker pen (Sharpie) for labeling tubes etc

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**Students must wear closed-toe shoes to lab. SDSU policy states that students wear appropriate clothing in laboratory settings.**

### **Academic dishonesty**

I have a zero-tolerance policy for cheating of any sort. If you are caught cheating on an exam or report you will receive a grade of zero on that exercise. The incident will be reported to the campus judicial officer and may lead to **disciplinary action** by the University.