

# MBIO 4500 Bacterial Physiology Spring 2015

Lecture MWF 1:00P – 1:50P N331

Lab W 2:00P – 4:50P N331

---

<b>Instructor</b>	My Lo Thao, Ph.D.
<b>Office/Telephone</b>	N276 / (209) 667-3649
<b>Office hours</b>	M 10:00A-11:30A, T 9:00P-10:30P, or by appointment
<b>E-mail</b>	<a href="mailto:mthao@csustan.edu">mthao@csustan.edu</a> <ul style="list-style-type: none"><li>• This is the best method to contact instructor regarding emergencies, setting up an appointment, or for questions with very short answers. Please ask complex questions during class or office hours. Questions regarding grades and/or those answered on the syllabus will not be acknowledged.</li><li>• Include your name and the course number in the subject line.</li></ul>
<b>Webpage</b>	moodle.csustan.edu

---

**Course Description:** Examination of bacterial physiology including discussions of cell structure and function, energetics, regulation of growth and metabolism, and environmental adaptation.

**Course objectives:** The overall aim of this course is to instill in students an appreciation for, and a working knowledge of, the diverse mechanisms that allow bacteria to survive and grow in ever-changing environments.

## Learning Objectives

- Understand the structure and function of the bacterial cell
- Understand how bacterial growth is possible due to, and as an outcome of, the flow of genetic information (DNA to RNA to Protein).
- Understand the range of bacterial metabolism (diverse metabolic capabilities) and energy production in the bacterial cell
- Understand the ability of bacteria to sense and respond to environmental conditions (adapt to ever-changing environments)

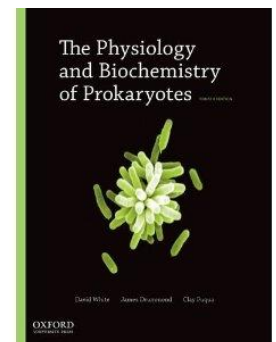
## COURSE REQUIREMENTS

**Prerequisites:** MBIO 3010/3032, BIOL 3310, CHEM 3010/3012, or equivalent.

**Required Text:** White, D. 2011. *The Physiology and Biochemistry of Prokaryotes*. Fourth Edition. Oxford University Press, New York, NY. ISBN 978-0-19-539304-0.

### **\*Note:**

- 1) No laptops, cameras, cell phones, or any other recording devices allowed in class.**
- 2) Audio\Video Recording** of lectures is not permitted without written consent from your instructor.



## Etiquette:

1. Arrive on time and prepared for class.
2. Turn off all cell phones and pagers.
3. Please do not carry on conversations with your neighbors once class has started. Such behavior is highly disrespectful and very distracting to me and to the other students around you.

## ADD/DROP Policies:

The add/drop policies for MBIO 4500 are the same as the university add/drop policies. Students should refer to the Class Schedule for the appropriate add/drop dates.

## Grading Policies:

1. **Academic Dishonesty and Misconduct:** Exams, reports, and presentations are indicators of individual performance. Copying off another student's exam, plagiarized reports, presentations or papers constitutes cheating. There is zero tolerance for cheating. Cheating in any capacity in this class will result in penalties ranging from a minimum of a zero on the assignment or exam to a maximum of expulsion from California State University, Stanislaus as indicated by the official University Policy regarding dishonesty and misconduct.
2. **Class attendance is vital to your success.** Attendance requires not only your physical presence, but your attention and participation as well. Students who are physically present, but inattentive (including, but not limited to, sleeping, excessive conversation, texting, e-mailing, web-surfing, being disruptive, arriving late, leaving early, etc.) may be asked to leave. Excessive absences or tardiness may result in disenrollment or reduction of grade. If you are absent on the days when students are presenting, you will **lose 10 points of your participation points per lecture period**. You are responsible for any information or assignments you missed in your absence. I highly recommend reading the assigned chapters before coming to class. **Lab attendance is mandatory!** If you have missed an entire exercise you will forfeit the entire number of points allotted for that lab report. Excessive tardiness or leaving early may constitute absences. **More than 2 lab absences will result in a penalty of 30 points deducted per absence from your total score, thereby significantly reduce your grade.**
3. You are expected to study regularly, and to consult your notes when you have a question. Your instructor will be happy to answer questions once you have made an honest effort to do so on your own. A question may sometimes be answered with a question, or your fellow classmates may be called upon to help answer it. This is to lead you to the answer, not embarrass you.
4. Exam date/time: changes will be made only in case of an emergency or if they conflict with official university activities. **Do not** schedule any appointments, nor make any travel plans that conflict with a scheduled exam.
5. Unless otherwise stated, exams will begin at the beginning of the scheduled class time. **If you are late then you will have less time to complete the exam. Traffic and/or car problems are not acceptable excuses for being late.**
6. Once you start the exam, you will not be allowed to leave the room until you have finished and turned in your exam.

7. You must turn off cell phones and remove baseball caps during exams. If your cell phone rings during an exam ten (10) points will be deducted from your score. Cell phones must be put away during exams. Taking out a cell phone during an exam is considered cheating, your exam will be confiscated, and you will receive a grade of F in the course.
8. After graded exams have been returned, you have one week to review exams or dispute errors; no grades will be changed after that time.
9. Questions that may appear on exams include multiple choice, matching, short answer, discussion, problem-solving and case study interpretation. You will need Scantron form # 882-E for the exams. Note that:
  - i. Only answers on the scantron will be graded, so transfer answers carefully
  - ii. Take care to erase well those answers you do not want marked
  - iii. Illegible answers in written portion will not be graded.
  - iv. Correct spelling and grammar are necessary for effective communication. Therefore, spelling and/or grammatical errors will result in loss of points on exams.
10. **Make-up exams given only under extenuating circumstances and only with proper documentation.** NOTE: Make-up exams may be different. Failure to appear at exam time without 24 hours prior notice to instructor with an appropriate excuse, or an appropriately documented emergency, will result in zero points for that exam. You may need Scantron form # 882-E for the exams. Note that:
  - a. only answers on the scantron will be graded, so transfer answers carefully
  - b. take care to erase well those answers you do not want marked
  - c. illegible answers in written portion will not be graded.

**11. Total points for course = 655**

3 exams (75 pts each)	225 pts	<b>Note:</b> Presentations are required of all students. Students who do not present will have additional points equal to that of the assignment deducted from their final score.
Journal article presentation	55 pts	
Lab reports	150 pts	
Lab notebook	50 pts	
Participation	25 pts	
Comprehensive final exam	150 pts	

**12. Grading** will be based on a percent scale:

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

**Note:**

- Take care of your grade. Remember you earn your grade; it is not given to you.
- Grades/scores will not be sent to students via email or be given over the telephone.
- Instructor will not calculate student's scores/grade.
- The instructor reserves the right to reduce your grade due to excessive absences and/or tardiness.

### 13. Course Page

Information for the course (syllabus, lecture notes, lab exercises, exam and other scores, other class materials, etc.) can be found on the course's Moodle page. Lecture materials **are copyrighted** and are only for the personal use of students enrolled in the course. **Do not** give the username/password to anyone else. If you do so, **no more** material will be provided.

How to enroll in Moodle:

- a. Go to the Moodle site - moodle.csustan.edu.
- b. Under Course Categories, locate and click on the course you need to enroll in - Microbiology, then MBIO 4500: Bacterial physiology.
- c. Create a Moodle account (this will be different than your CSU Stan login account). Please remember your login and password. After your account is created and confirmed you will be able to view your Moodle course site
- d. Enter the enrollment key (i.e., password) for the course. The enrollment key is: mbio4500001.
- e. Once enrolled, go to your 'Profile Settings > Edit Profile'. Make sure that the information there is accurate (e.g., your full name has been entered, your email address is correct). At the bottom of the page enter your student identification number.

### 14. Paper presentations

You will present a primary research article published in the Journal of Bacteriology (January 2014 - Present). The paper should address a physiological aspect of a prokaryote other than *E. coli* or *Salmonella*. Your selection must be approved by instructor by **Monday April 8<sup>th</sup> by 2 pm.**

Each Powerpoint presentation will be 12 minutes long with 3 minutes for questions/class discussion and will cover the following for 2-3 of the presented experiments:

- a) Background
- b) Purpose for carrying out experiment(s)
- c) Experimental technique/method not discussed in class
- d) Results
- e) Conclusion/discussion of results.

Each student will provide a 1-2 sentence statement summarizing the conclusion(s) of the paper to members of the class and instructor. This information will be included on the final exam.

#### **Guidelines for oral presentations (content and delivery are both important)**

1. Preparation and knowledge of materials
  - Do your homework to fill in gaps of knowledge - resources outside of paper
  - Anticipate questions that may be raised, find answers
  - When reading paper, be critical of techniques/methods used, results obtained and conclusions drawn based on results

2. Organized the presentation to flow from one section to another.
  - Break down procedures, results etc. According to questions/objectives
    - Sufficient introduction to topic and problem
    - Clear statement of objectives/goals
    - Clear explanation of experiments (methods and procedures used)
    - Clear explanation of results
      - Detail explanation using figures and tables as visual aids
      - Use pictures to illustrate what you are speaking about
    - Discuss result and draw conclusion
3. Rehearse the presentation to run in the allotted time
  - Speak clearly, loud enough to be heard and do not talk too fast (happens when one is nervous)
  - Have variety in your voice (tone). Don't speak in a monotone or mumble.
4. Avoid distracting body movements.
  - Avoid cracking knuckles, jingling keys in pocket, using laser pointer inappropriately, etc.
  - Do use hand gestures
5. Do move around, instead of remaining in a "frozen" state
  - Avoid fidgeting, swaying or rocking in place, or have your back to the audience.
  - Avoid pacing or moving around so much you make the audience dizzy.
6. Make and maintain eye contact with the audience.
  - Make eye contact with every person in the room
  - Plug into the audience's brain
7. Make short notes but avoid reading your presentations - slides or notes
8. Display enthusiasm, passion and genuine concern for your subject.
9. Avoid grammar errors, misspellings, typos in presentation
  - Unacceptable because of grammar and spell check
  - Shows audience your indifference
10. Avoid too many distracting "Uh"s & "Like"s, etc.
11. **Practice, practice, practice! The more prepared you feel, the less nervous you'll be.**

## 15. Additional work

Throughout the semester, you will be given problem sets/study guides. These are not collected, but are designed to test your knowledge and to prepare you for exams. I would be happy to discuss these during my office hours.

## 16. Lab Notebooks and Lab Reports

The laboratory portion of this course is mandatory and comprises a major portion of the total points possible. This portion of your grade comes from laboratory reports and lab notebook.

### Lab reports:

Laboratory reports will be collected as loose leaf pages stapled together. Lab reports are required to be done on a word processor. I strongly recommend the use of a computer and using programs such as excel for graphing, but this is not required. If not using a computer, graphing must be done neatly on graph paper using a straight edge to make straight lines. Pages must be numbered and there must be a table of contents.

Reports will be graded on the basis of academic excellence, neatness, spelling, grammar, and most importantly, on the demonstration that **original thought** was put into your interpretation of the experiment (this should be evident in your discussion). **These reports are to be polished, professional and well written documents of the experiments and what you learned. A report that looks thrown together and sloppy will receive very few points.** If at **any** time you have questions about data presentation, interpretation and/or calculations, please come see me!

Each Lab report is worth the number of points indicated in the Lab Schedule. Laboratory reports must be turned in on time for consideration of full credit. They will be accepted up to a week late only and will be docked 10% of total points for report per day late (including weekends!!). **I will not accept lab reports by email. If you miss a laboratory session from an unexcused absence you will forfeit all of the points possible for that lab!!**

Each experiment write up must include the following sections in this specific order AND with the headings in bold below:

- a. Title of the experiment—a detailed title that indicates what you did
- b. **Purpose or Hypothesis:** Statement(s) of the **purpose(s)** of the experiment (**in your own words!!!**). This should simply state why you are doing this experiment and what you hope to learn from doing it or predict to find from the data you will generate.
- c. **Introduction:** Briefly discuss scientific theory or principals that apply to this experiment. This should elaborate on the physiology of the process you are investigating.
- d. **Procedure** (Reference to Lab exercise handout or include procedure): **You must write in complete sentences!** This should be written as a narrative, not bullet points or a list of steps, and in detail so that you completely understand what is going on in the lab period and so that someone else can replicate your work precisely and easily. Any changes made to the procedure provided in the manual must be cited here.
- e. **Results:** This section should contain your observations and all data obtained in tables and figures. **This section is a point by point description of your findings and the presentation of data to support them.** If you refer to a table or a figure in your summary to point out data that supports your results (**and you should**), it should be written Table 1 or Figure 1; *i.e.*

“as shown in Table 3, or Figure 3)”. “Table” and “Figure” are not in capital letters in the text. It will also contain calculations. Here are some guidelines for presenting data.

- i. All calculations or a sample calculation in the case of repetitive calculations must be shown in a neat, organized manner and as a footnote to the tables or figures in which the calculated data appear. If the calculated data are to appear in the text, a separate page outlining the calculations is required.
- ii. Where possible, present data in tabular form in the format used in the publications of the American Society of Microbiology. Each table must be labeled at **the top** by a number (e.g. TABLE 1) and a **detailed** title must follow that describes the information presented in the table. See example below.
- iii. When information/data are presented by a graph, diagram, or a photograph, this is referred to as a figure and must be referred to as FIG. 1 or FIGURE 1 placed **below** the presented information followed by a title and a legend that describes the information presented in the figure.

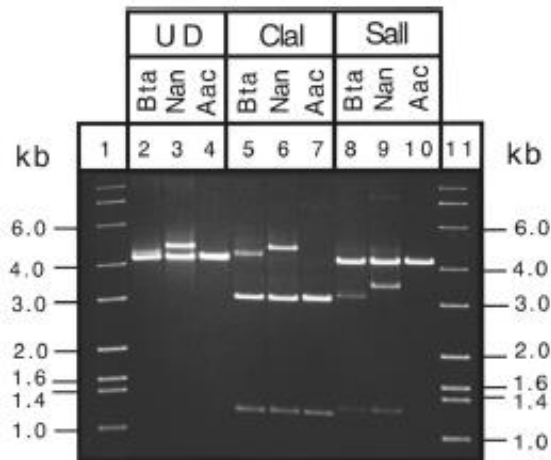


FIG. 1. Agarose gel electrophoresis of 16S-23S rDNA PCR products amplified from total DNA of three species of whiteflies. Lanes 1 and 11, molecular size standards; UD, undigested DNA; ClaI and SalI, restriction enzymes; Bta, *B. tabaci*; Nan, *N. andropogonis*; Aac, *A. aceris*. Bands of 0.1 kb (lanes 5, 6, and 7) and 0.2 kb (lanes 5 and 6) are not visible in the photograph.

TABLE 2. Rates of evolution of the combined 16S and 23S rDNA genes in psyllid symbionts relative to rates in other lineages in the  $\gamma$  subdivision of the Proteobacteria<sup>a</sup>

Organism to which compared	K(1-2)	K(1-3)	K(2-3)	K(0-1)/K(0-2)	$\tau$
<i>Z. palmar</i>	0.33	0.38	0.23	2.77	11.40 <sup>b</sup>
<i>E. coli</i>	0.32	0.34	0.21	2.34	10.65 <sup>b</sup>
P endosymbiont (whitefly)	0.30	0.35	0.24	2.07	7.96 <sup>b</sup>
<i>B. aphidicola</i>	0.30	0.34	0.24	2.03	8.40 <sup>b</sup>

<sup>a</sup> In all comparisons, the outgroup is *A. tumefaciens* (taxon 3), the psyllid symbiont is *P. vesuvius* (taxon 1), and the comparison is to a free-living or endosymbiotic  $\gamma$ -subdivision bacterium as listed (taxon 2). The null hypothesis is  $K(1-3) = K(2-3)$ .

<sup>b</sup>  $P < 0.0001$ .

- f. **Discussion** of your results. This should include a short summary of your results and a comparison of your results with the expected results and/or results obtained from other teams in class (i.e. what principles of physiology are demonstrated and what data from your experiment support this? Do they agree with expected results? What broader conclusions can you draw from this experiment that might fit into previous discussions?). Cite specific data from your results to support your statements. **Keep in mind, we are interested in aspects of physiology so all discussions should contain some well developed sections describing what you learned about bacterial physiology from a particular experiment.**
- g. **Answer questions where present** at the end of each experiment.

## Laboratory Notebook:

The most important piece of equipment you will use when working in lab is your lab notebook. Since science is built upon the premise that results are reproducible, we must leave detailed information so others could reproduce our work if they read our notes. **For this class, you should use a 3-ring binder (½ inch).** Your notebook is the only source of information of all that you have done in lab. It should be an accurate account of what you did, why you did it, when you did it, what the results were, and what these results mean. Here are a few simple rules to keep in mind while developing your notebook.

- 1) Notebooks do not have to be "neat" but they should be legible (i.e. write neat enough for me to be able to read it). Record the date at the top of each page. Do not recopy your notes. NEVER!! By recopying your notes, you may filter out some information that seems insignificant at the time, but may be very valuable later.

Also, a notebook is not designed to be a duplication of the lab exercise instructions. Just cite the lab exercise, and then record any deviations from the protocol.

- 2) Divide your notebook into 2 sections: a) copies of protocols you use; b) your notes and hard copies of your data.
- 3) You may use either pen or pencil, but if you use pencil, make sure it is dark enough to be seen easily. If you make a mistake, neatly cross it out and continue.
- 4) Explain why you are performing a particular procedure, i.e. What is the purpose and what do you expect to see? Is there more than one possible outcome?
- 5) Record all measurements and calculations you perform. It is very important to include hard copies of your data followed by interpretations of the results, i.e., What do the numbers mean??! Refer to the hard copy of your data and write detailed explanations of what your data mean to you and what you need to do next.
- 6) If you were to repeat the experiment, what would you change?
- 7) Record any observations that you think might be significant. If you deviated from the normal protocol, you should record all variations.
- 8) Keeping a detailed lab book will help you in the writing of the lab report.

### **Tentative Lecture Schedule (open to revision):**

Date	Related reading	Lecture topic	Lab exercise	Points for lab report	Lab topic
Jan	28	Introduction			Introduction, drawer check-in, safety review
	30	Ch. 1			
Feb	2	Cell Structure and Function (cont'd)			
	4	Cell Structure and Function (cont'd)	1	10	Pipetting and the Beer-Lambert law
	6	Ch. 2			Growth and Cell Division (cont'd)



Date	Related reading	Lecture topic	Lab exercise	Points for lab report	Lab topic	
Feb	9	Growth and Cell Division (cont'd)				
	11	Growth and Cell Division (cont'd)	2	20	Techniques for measuring bacterial growth: serial dilution, viable count, turbidity	
	13	Ch. 4	Membrane Bioenergetics			
	16	Ch. 5	Electron Transport			
	18	<b>Start lab early</b>	3	60	Bacterial growth curve of <i>E. coli</i> : minimal vs. rich media • save cell pellets for lab exercise 4	
	20	Electron Transport (cont'd)				
	23	Ch. 8	Bioenergetics in the Cytosol			
	25	Ch. 6	Photosynthesis			Chemical determination of RNA and protein in bacterial cells grown in minimal and complex medium a. Preparation of cell extractions and protein concentration analysis of <i>E. coli</i> cells grown in a rich medium and a minimal medium
27	<b>Exam I</b>					
Mar	2	Photosynthesis (cont'd)				
	4	Ch.14	C <sub>1</sub> Metabolism			b. RNA concentration analysis in <i>E. coli</i> cells grown in minimal and complex medium
	6	C <sub>1</sub> Metabolism (cont'd)				
	9	Ch. 9	Central Metabolic Pathways			
	11		Central Metabolic Pathways (cont'd)			c. Data analysis
	13	Ch. 7	Regulation of Metabolic Pathways			
	16	Ch. 13	Inorganic Metabolism			
	18	<b>Start lab early</b>	4	30	Regulation of the <i>E. coli lac</i> operon/ $\beta$ -gal assay	
	20	Ch. 15	Inorganic Metabolism (cont'd)			
	23	<b>Exam II</b>				
	25		Fermentations/Applications to Biotechnology			Regulation of the <i>E. coli lac</i> operon (cont'd)
	27	Ch. 3, 11	Macromolecular synthesis: DNA, RNA, Protein			
30	Macromolecular synthesis (cont'd)					

Date	Related reading	Lecture topic	Lab exercise	Points for lab report	Lab topic	
Apr	1	Field assignment – Paper selection				
	3					
	6	Spring break				
	8					
	10					
	13	Ch. 17	Solute Transport			
	15		Solute Transport (cont'd)			Regulation of the <i>E. coli lac</i> operon (cont'd)
	17	Ch. 16	Responses to environmental stress			
	20		Responses to environmental stress (cont'd)			
	22	Start lab early		5	30	Cell survival strategies a. heat resistance of exponential vs. stationary cells
	24	Ch. 19	Responses to environmental cues			
27		Responses to environmental cues (cont'd)				
29	Ch. 20	Chemotaxis, photoresponses, aerotaxis			b. heat resistance of stationary cells grown in minimal media vs rich media	
May	1	Exam III				
	4	Ch. 22	Cell to cell communication			
	6	Ch. 23	Bacterial Development (cont'd)			Lab report 5 due; drawers check out
	8	Warrior day – no class!				
	11		Bacterial Development (cont'd)			
	13		Student presentations (3)			Student Presentations (9)
	15		Student Presentations (3)			
	22	Final exam 11:15A – 1:15P				

Come to the lab FULLY PREPARED to do the work for that period and plan to stay the ENTIRE TIME. READ YOUR LAB PROTOCOL IN ADVANCE so you will understand what you are going to do and why. Come prepared to ask questions if you do not understand something. Your attendance and participation will have a direct and large effect on your final grade. The idea is to enjoy the lab but also to THINK and to WORK.

**Please note: appropriate laboratory conduct and safety are extremely importance for your safety and the safety of others. Failure to follow safety rules as discussed in class will result in the lowering of your grade or dismissal from the course.**