**MICR 3300: Microbial Genetics**
**Fall 2018 Cal State LA**
**Lecture (01): T, R 10:00am-10:50am, FA 345**
**Lab (02): T 11:00 am-1:30pm, ASCL 126**
**Lab (03): T 2:00pm-4:30pm, ASCL 126**

## INSTRUCTORS

Weeks 1-7:
Dr. Susan Cohen (01, 02, 03); Office: La Kretz Hall 354; Office Hours: R 11am-12pm or by appointment
email: scohen8@calstatela.edu; phone (323) 343-2091

Weeks 7-15:
Dr. Gayle Boxx (01); Office: TBA; Office Hours: TBA
email: TBA

Shakila Rahman (02); Office: TBD; Office Hours: TBD
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Bita Bahrami (03); Office: Library Palmer Wing 2097; Office Hours: W 8:30am-10:30am
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## COURSE DESCRIPTION

In this course we will cover the fundamental principles of microbial genetics with an emphasis on genetic exchange, genetic manipulation and applications with environmentally, industrially and medically significant organisms. Lecture 2 hours per week. Laboratory 3 hours per week.
**Prerequisites-** MICR 3100/BIOL 3100, grade C or higher or instructor consent.

## TEXTBOOKS

Lecture- Molecular Genetics of Bacteria, 4th ed., by L. Snyder, J. E. Peters, T. M. Henkin and W. Champness, ASM Press, Washington, DC. Book ISBN or Item Number: 978-1555816278. Assigned reading is listed on the Schedule page. It is highly recommended that you read the material before lecture in order to have a complete understanding of the topics being presented.

Lab- No textbook is required for lab; exercise protocols will be uploaded onto the course Canvas site prior to the lab experiments. Read the lab manual before you come to class. You **must** have a lab coat and closed toe shoes in order to stay in the laboratory. You will also be required to maintain and laboratory notebook, which will be submitted at the end of the semester.

This course will use CANVAS as the online learning management system. Cal State LA CANVAS website: https://canvas.calstatela.edu. Log onto CANVAS using your myCSULA ID and password. If you do not have a myCSULA user ID, please visit ITS Help Desk located on the first floor of the Library South (Palmer Wing).

## COURSE OBJECTIVES/OUTCOMES

Upon the completion of this course, you will be able to:

- Demonstrate the understanding of microorganisms' chromosomal structure, replication and segregation processes
- Define gene expression processes including transcription and translation
- Develop proficiency in bacterial genetic analysis, experimental design and analysis
- Become proficient in the use of genetic reporter systems
- Define modes of genetic material exchanges between and among microorganisms
- Discuss the structure and function of bacteriophages and their interactions with host cells
- Become proficient in evaluating experimental results and ordering genetic pathways
- Perform techniques relevant to microbial genetics including primer design for DNA amplification by polymerase chain reaction, DNA restriction digest and agarose gel electrophoresis, DNA transformation, plasmid isolation and conjugation
- Critically evaluate the primary literature
- Develop critical thinking skills
- Demonstrate improved technical analysis, written and oral communication skills

I know this seems like a lot, but you can do well (and I expect you to do well!) if you come to class prepared, participate in class discussions and turn in your assignments on time.

## COURSE POLICIES

**Attendance/Participation:** You are responsible for all material presented in class, including announcements about changes in course procedures. Examination content will be heavily based on materials presented in lectures. Attendance for lab sessions is **mandatory** and strictly enforced; there will be point deductions for missing a lab sections without a documented excusable absence. If you are late more than 10 min for the lab, 2 points will be deducted. If you are absent from lab without satisfactorily justified and documented reason, 5 points will be deducted. Participation points will be evaluated by your attendance in class, participation in class discussions and active learning exercises, as well as attendance of office hours. There will be active learning activities during class without prior announcement and will be incorporated into participation points for the course. There will be absolutely no make up for missed class activities.

**No make-up examinations**: Missed exams will be given as "0 points" unless satisfactorily justified (e.g. doctor's note). The University Academic Honesty Policy and the Drop/Incomplete Policy explained in the University General Catalogue will be strictly followed. Students are responsible for the prerequisites for this course and are encouraged to discuss any questions regarding the policies and prerequisites with the instructor on the first day of the class.

**Americans with Disabilities Act (ADA):** Reasonable accommodation will be provided to any student who is registered with the Office of Students with Disabilities and requests needed accommodation, please contact the instructor to arrange appropriate accommodations. For more information visit http://web.calstatela.edu/osd

**Online Quizzes:** Post-lecture quizzes will be given via CANVAS. Each quiz will be available for 24 hours after its announcement during lecture. No makeup will be given for missed quizzes. You will be given two attempts and the higher score will be counted toward your final grade. No makeup quizzes will be allowed.

**Lab Quizzes:** Pre- and Post-laboratory quizzes will be taken in class. Pre-lab quizzes worth 1-3 points each will be given at the beginning of lab on week's 9-14. Students will be working in groups and participation will be evaluated by their lab mates in addition to the instructor.

**Email:** All emails pertaining to the course **MUST** come from your CSULA email account, with the course number in the subject line. E-mail correspondence with the professor must be professional.

**ASSIGNMENTS**

**Microbiology in the news-** This writing exercise will be worth 5 points and will consist of a one paragraph report that summarizes a **popular science** article on the topic of microbial genetics. You will work independently to identify a recent popular science article that highlights a recent scientific advance or interesting perspective on topics related to microbial genetics, including but not limited to roles that bacteria play in the environment, global or local community, disease progression or bacteria as medical sensors. You will write up a short summary of the article, no more than one paragraph, describing:

1. The main point of the article, what finding, discovery or observation was made
2. The immediate impacts of the observation/finding
3. The long term impacts this finding

Assignments will be submitted as either a word document or PDF on CANVAS, before class on **September 25th**. Late reports will not be accepted.

**Popular science** is defined as an interpretation of science intended for a general audience. While science journalism focuses on recent scientific developments, **popular science** is more broad-ranging.

**Literature Project-** Scientific literature search, writing and presentation exercise
This writing exercise will be worth a total of 70 points and will consist of an outline, final report and in-class presentation summarizing a primary scientific paper related to microbial genetics. The paper will be assigned to each student on a date to be announced. It is your responsibility to find the paper via PubMed or library and print it out. You are tasked with reading and studying the paper in detail. Your reports should cover the following four sections with clear subtitles:

Background- Explain why the study was performed. Describe the main point of the article you were assigned, specifically address why the authors perform their study and what prior information motivated the authors to perform their study. You will need to look up and cite two additional references published before and cited by this publication, in order to determine what was known before this study was published and what results encouraged the authors to perform their study.
Methods- Identify the key experiments performed in this study and how they contributed to the main goal of the paper. Do not spend time summarizing growth conditions, strain, and plasmid or

primer design. Do not paraphrase the methods section of the paper. Instead you should focus on ONE novel or interesting method. Do not describe the protocol for how to perform the procedure, but rather explain why the procedure is done. Your analysis should cover the overall purpose of the method, why each critical step is performed, what the results look like and how they are interpreted.
Results- Explain the observed results and how they lead the authors to perform further experiments or to make specific conclusions.
Conclusions- Describe the conclusions of the paper. Explain the findings of the paper and how these results contribute to the significance of this work to the field. Describe what YOU think the immediate (short-term) and greater (long-term) impacts of this study and highlight any further research that should be done.
References- You should include a reference section were you reference the main reference (the paper you were assigned), the two references identified in your background search as well as any other references used. References should follow the format below
1. Author Surname Author Initial. Year Published. Title. Publication Title Volume number:Pages Used.

Your reports should follow routine rules relative to the format of species names and gene names. The explanation should be clear enough that a fellow classmate could read it and understand it.

**Outline**: In bullet point format you should address the following for each section:
Background- Briefly describe the main point of the article you were assigned. Specifically address why did the authors perform their study and what prior information motivated the authors to perform their study.
Methods- Identify and list the key experiment(s) performed in the study. Determine which method you have chosen to explain in greater detail in the final draft.
Results- Identify the key results obtained by the authors.
Conclusions- Highlight the main conclusions of the paper. List (briefly) what you think the immediate and greater impacts of this study are.
References- You should correctly site the article you were assigned and identify at least 2 other references that motivated the authors to perform their study.

**Final Report**: Using the comments and feedback you got from the outline you can begin to write your final report. The final report should be 4 to 5 typed pages in length with double spacing between lines. Font of Times New Roman 12 point size is to be used. Reports will be submitted before class on the dates listed below as either a word document or PDF. Reports handed-in late will result in deduction of final report points (10% deduction per day after due date).

**Presentation**: You will prepare a **5 min** presentation summarizing the key findings of the report and present it to the class. You must include a visual; including but not limited to writing on the board, a figure from the paper or set of power point slides (don't forget about time limitations when preparing your slides), please submit them as a separate file on CANVAS by 8pm on November 26$^{th}$. Due to time restrictions please do NOT present your methods unless critical to your explanation of the paper.

**Reports should be submitted before class on CANVAS on the dates listed below:**

| | | |
|---|---|---|
| Outline | 15 points | October 30th |
| Final report | 45 points | November 27th |
| Presentation | 10 points | November 27th - December 4th |

Plagiarism is a serious offense. Plagiarism is defined at Cal State L.A. as the act of using ideas, words, or work of another person or persons as if they were one's own, without giving proper credit to the original source. This includes, but is not limited to, turning in all or part of an essay written by someone other than yourself (a friend, an internet source, etc.) and claiming it as your own, and including information or ideas from research material without citing the source. If you take any text from somebody else, you must make it clear the text is being quoted and where the text comes from. If any section of your report is plagiarized you will receive a zero on the assignment.

## Lab reports:

### 1-page Laboratory Project Proposal

Task/Assignment: For this project proposal you are tasked with

1. *Reviewing* the *clpX*-Interaction RB-TnSeq data and *identifying* a gene that you are interested in learning more about. In particular, you want to pick a gene that has a "good" fitness score (greater than 1 or less than -1) and a strong statistical significance that you think will help us learn more about the roles that ClpX plays in the cell division process in *S. elongatus*.
2. *Research* that gene, by reading the text book or other reputable sources of information (journal articles etc.). Note you may not be able to read an article about your gene of interest in *S. elongatus* but you may find an article that studies that gene in another organism!
3. *Synthesize* the research that you have done and come up with a strong argument for why the lab should focus on your gene of interest, including a hypothesis of how the gene you picked might function with *clpX* to promote or negate its effects on cell division.
4. *Write* a 1-page report explaining why you chose your gene of interest. You will be evaluated by the following criteria:
    a. Describe what is known about the gene you chose (in either *S. elongatus* or another bacterial species)
    b. If known, describe the phenotype of mutating that gene in either *S. elongatus* or another bacterial species
    c. State how disruption of your gene effects fitness as discovered by the *clpX* Interaction-RB-TnSeq screen as well as the statistics and why you believe them to be significant
    d. State a hypothesis for how you think your gene of interest interacts with *clpX* to promote or negate its effects on cell division
    e. Reference any data or information you retrieved from other sources (websites, journal articles, etc.)
5. You will submit your report on CANVAS as a word document (.doc or .docx) by Tuesday August 28, 2018 by 10am

### Project Proposal Presentation

Assignment Description: As described in the laboratory manual, each person will select a gene of interest they would like to spend more time during the semester investigating. However, only ~5 genes will be selected by the class to be investigated by groups of 3-4 students during the semester. During the laboratory section of Week 2, you will have 5-minuites to pitch to the rest of the class,

why your gene of interest should be one of the 5 genes selected for further investigation. During your presentation you should highlight the following:

1. *Describe your gene of interest*. Why did you select it? What is known about this gene? Where did you find this information?
2. *State your hypothesis*. How do you propose that your gene of interest interacts with *clpX* to promote or negate its effects on cell division?
3. You must have a visual. You are encouraged to draw on the board. However, if you would prefer you may have one powerpoint slide or one image. Images must be submitted according to instructions (see assignment details on CANVAS).

**Laboratory Project 1- Final Presentation**

Assignment Description: Each group will have ~30-min to present the results of their laboratory projects. Your group will also be expected to answer questions from fellow students as well as the instructor during this time. You will be graded not by how far into the project your group got, but rather your understanding of what your group was able to accomplish. Both your individual contributions to the group presentation as well the performance of the group as a whole will be considered in determining your grade.

Your group presentation you should highlight the following:

1. *Describe* your gene of interest and why it was chosen? Explain what was known previously about your gene and *state* your group's hypothesis for how your gene of interest interacts with *clpX*.
2. *Describe* how far into the project your group got (how many MODULES your group completed). *Explain* what problems your group encountered along the way and what strategies your group took to troubleshoot and overcome these problems.
3. *Synthesize* your results (showing your data when necessary) and *describe* what you have learned about your gene of interest and how it interacts with *clpX* to regulate cell division.
4. *Propose* a future experiment(s) that could be or should be done based on your groups results to further investigate the function of this gene and how it interacts with *clpX* to regulate cell division.
5. *Explain* what you learned from this experience and how it differed from other laboratory courses you have taken.

**Laboratory Notebooks-** You are expected to keep a detailed, legible laboratory notebook. Your lab notebook should be a record of what you did during each lab section and include a complete record of the procedures, reagents, data and your thoughts on the experiments you performed. Laboratory notebooks should include a table of contents and numbered pages. All experiments should be entered into the laboratory notebook and contain the following information: title of experiment, one sentence introduction of the experiment, experimental protocol, results and discussion. All drawings and figures must be clearly labeled. You will want to include what worked, what did not work, what you might change for next time. You will submit your lab notebooks to the instructor at the end of the semester.

**Classroom etiquette-** For both the lecture and laboratory components of this course the classroom is an environment that should foster a learning-centered environment where faculty and students are unhindered by disruptive behavior. You are expected to conduct yourself in a mature and

collegial manner. You should be respectful of your professors, instructors and fellow peers. In addition students should abide by the following guidelines:

- Be ready to start class ON TIME. Stop all conversations and focus your attention to the instructor
- Do not have private conversations while the instructor or a fellow peer is speaking
- Turn off or silence your phone

This syllabus is subject to change. If a change is made, I will immediately notify the class and post a revised syllabus.

**Performance Evaluation:** **600 point total**

**Lecture: 400 points total**

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|---|---|
| Examination 1 | 75 |
| Examination 2 | 75 |
| Quizzes (5 total, 5 pts each) | 25 |
| Microbiology in the news | 5 |
| Literature project | 70 |
| Participation | 20 |
| Final (comprehensive) | 130 |

**Lab: 200 points total**

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|---|---|
| 1-pg project proposal | 15 |
| Project proposal presentation | 5 |
| Project 1 final presentation | 20 |
| 6 Pre-Lab Quizzes weeks 9-14 | 15 |
| Post-Lab Quizzes | 45 |
| Lab notebook | 30 |
| Participation | 20 |
| Final | 50 |

Final grades will be based on % of achievable points obtained:
Total points earned / 600 points x 100 = % achieved

| | | | | |
|---|---|---|---|---|
| | B+: 88-89% | C+: 78-79% | D+: 68-69% | F: ≤ 59% |
| A: ≥92% | B: 82-87% | C: 72-77% | D: 62-67% | |
| A-: 90-91% | B-: 80-81% | C-: 70-71% | D-: 60-61% | |

In borderline cases (passing/non-passing or grade levels), participation and performance in lecture will be considered for the final grade.

**Lecture Schedule**

| Week | | Lecture | Readings/Assignments |
|---|---|---|---|
| 1 | Aug 21 | Chromosome Structure, Replication and Segregation I | Ch.1, pg. 13-27 |
| | Aug 23 | Chromosome Structure, Replication and Segregation II | Ch. 1, pg. 31-38, 47-53 |
| 2 | Aug 28 | Chromosome Structure, Replication and Segregation III | Ch. 1, pg. 40-47 **Quiz 1** |
| | Aug 30 | Gene Expression: Transcription | Ch. 2 |
| 3 | Sept 4 | Gene Expression: Translation | Ch. 2 |
| | Sept 6 | Bacterial Genetic Analysis I | Ch. 3 |
| 4 | Sept 11 | Bacterial Genetic Analysis II | Ch. 3 **Quiz 2** |
| | Sept 13 | Bacterial Genetic Analysis III | Ch. 3 |
| 5 | Sept 18 | **Examination I** | |
| | Sept 20 | Regulation of Gene Expression I | Ch. 12 |
| 6 | Sept 25 | Regulation of Gene Expression II | Ch. 12 **Micro in the news report due** |
| | Sept 27 | Plasmids | Ch. 4 |
| 7 | Oct 2 | Conjugation I | Ch. 5 **Quiz 3** |
| | Oct 5 | Conjugation II | Ch. 5 |
| 8 | Oct 9 | Transformation | Ch. 6 |
| | Oct 11 | Lytic Bacteriophages | Ch. 7 |
| 9 | Oct 16 | Phage λ and Lysogeny | Ch. 8 **Quiz 4** |
| | Oct 18 | Transposition | Ch. 9 |
| | Oct 23 | **Examination II** | |
| | Oct 25 | Molecular Basis of Recombination | Ch. 10 |
| 10 | Oct 30 | DNA Repair and Mutagenesis I | Ch. 11 **Literature Report Outline due** |
| | Nov 1 | DNA Repair and Mutagenesis II | Ch. 11 |
| 11 | Nov 6 | Membrane proteins and genetic analysis of transmembrane domain proteins | Ch. 14 |
| | Nov 8 | Genetic analysis of sporulation in *B. subtilis* I | Ch. 14 |
| 12 | Nov 13 | Genetic analysis of sporulation in *B. subtilis* II | Ch. 14 **Quiz 5** |
| | Nov 15 | Quorum sensing | |
| 13 | Nov 20 | **Fall Recess- No Class** | |
| | Nov 22 | **Thanksgiving Holiday- No Class** | |
| 14 | Nov 27 | Student project presentation I | **Final Literature Projects Due** |
| | Nov 29 | Student project presentation II | |
| 15 | Dec 4 | Student project presentation III | |
| | Dec 6 | Review Session | |

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|---|---|---|---|
| Final exam | Dec 11 | **Lecture final exam: Tuesday December 11, 9:30 am to 11:30 am** | |

**Lab Schedule**

| Week | | Lab | Assignments |
|---|---|---|---|
| 1 | Aug 21 | Lab safety overview; Introduction to Project 1; in-class time to research topic | |
| 2 | Aug 28 | Student presentations on Project proposals | 1 page Project Proposal due |
| 3 | Sept 4 | Groups will be assigned and begin working on Project 1 | |
| 4 | Sept 11 | Continue working on Project 1 | |
| 5 | Sept 18 | Continue working on Project 1 | |
| 6 | Sept 25 | Continue working on Project 1 | |
| 7 | Oct 2 | Continue working on Project 1 | |
| 8 | Oct 9 | **Project 1Lab Presentations** | |
| 9 | Oct 16 | Project 2: Conjugation | |
| 10 | Oct 23 | Conjugation (Project 2) observation and analysis; ABE-Lab 2, Digest of pKAN-R and pARA plasmids | Read ABE manual pages 54-62 |
| 11 | Oct 30 | ABE-Lab 3, Building the pARA-R plasmid | Read ABE manual pages 69-74 |
| 12 | Nov 6 | ABE-Lab 4, Verification of Restriction and Ligation using Gel Electrophoresis | Read ABE manual pages 83-89 |
| 13 | Nov 13 | ABE-Lab 5, Transforming bacteria with a recombinant plasmid [pARA-R] | Read ABE manual pages 94-108 |
| 14 | Nov 27 | ABE-Lab 6, Purifying fluorescent protein | Read ABE manual pages 206-213 |
| 15 | Dec 4 | **Lab Final Exam (Weeks 9-14 only)** | |