****Applied and Environmental Microbiology- MICR3900****

***California State University, Los AngelesCollege of Natural and Social Sciences***

**Lecture Instructor**: Dr. Gustavo A. Ramírez

**Canvas course name**: Applied & Environmental Micro MICR 3900-01 (33964)

**Office Location**: ASCL – La Kretz Hall 218

**Email**: gramir157@calstatela.edu

**Office Hours**: Wednesday, 10-11 am or via Zoom by appointment

**Class Days/Time**: 01 MICR 3900: Mon & Wed, 9:00-9:50 am in SH 266.

**Labs:** 02 M 10:55 am-1:25 pm ASCL 242 [Instructor, Gustavo A. Ramírez]

03 W 10:55 am-1:25 pm ASCL 242 [Instructor, Howard Xu]

**Course Structure**: In-person instruction.

We will use Canvas which is a Learning Management System (LMS). Canvas website: <http://www.calstatela.edu/cetl/edtech/using-canvas-first-time>

For an assistance with Canvas, please use this link:

<https://community.canvaslms.com/docs/DOC-10701-canvas-student-guide-table-of-contents>

You will need to have an up-to-date browser, operating system and some additional software on your computer/tablet to take this class. Check the Internet Browser configurations. Some of the documents in this course will be available to you in PDF format. If you do not have Adobe Acrobat Reader software on your computer, you can download it by going to <http://get.adobe.com/reader/>.

# **A BRIEF COURSE DESCRIPTION**

Interactions of microorganisms with their environment and the application of microorganisms in food and biotech industries, agriculture, and bioremediation. Emphasis on microbial diversity, distribution, and function within ecosystems. Lecture 2 hours, laboratory 3 hours including a required field trip.

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# **PREREQUISITES:**

Grade of C or higher in (BIOL 3100 or MICR 3100) or instructor consent.

# **COURSE LEARNING OUTCOMES**

Upon completion of this course, students will be able to:

* Discuss the ubiquity of microorganisms in our environment;
* Discuss the diversity of microorganisms;
* Properly sample, transport and process environmental samples containing microorganisms;
* Describe the different environments in which microorganisms are found;
* Distinguish between molecular and culture-based methods of microbial characterizations;
* Describe the major biogeochemical cycles in the environment;
* Describe the application of microorganisms to industrial processes;
* Culture microbes from environmental samples;
* Quantify microbes from samples such as water, soil or food;
* Identify microorganisms based on 16S rRNA.
* Generate a phylogenomic analyses using custom command-line software

# **HOW WE WILL WORK TOGETHER**

We will use Canvas for all the course content, assignments and grading. All materials including lecture readings and laboratory exercises will be available online via Canvas. Readings will be announced in class or can be found in this syllabus. Some hand-outs will only be available in class. It’s critical to your success that you not miss class or in an emergency, make sure a friend picks up a handout for you.

Please check the course syllabus regularly and make sure you bring all materials (such as relevant readings and assignments) with you to class to support your participation and success. Let’s all agree, as members of this learning community, to be respectful of one another and avoid actions that take advantage of other members of our community.

We live in the digital age. We all depend on our cell phones and computers to varying degrees. Let’s also agree to restrict cell phone and computer use during class time to course related activities only. This is just as difficult for me as it is for you but I strongly believe we need to protect our time together.

I will make every effort to communicate frequently with you through announcements and postings on Canvas. You can also email me or contact me via Canvas inbox. The semester goes quickly. Our time together is limited and precious. So please, don’t be late to class and don’t miss class.

**COURSE AND UNIVERSITY POLICIES**

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. Below are relevant links. Please review them.

**Catalog Information and Basic University Policies**:

<http://ecatalog.calstatela.edu/content.php?catoid=25&navoid=2591>

**Procedures and Regulations:** <http://ecatalog.calstatela.edu/content.php?catoid=25&navoid=2596>

**Student Conduct**:

<http://ecatalog.calstatela.edu/content.php?catoid=25&navoid=2525>

**Academic Honesty/Plagiarism**: Students are expected to read and abide by the University Instructional Policies on Academic Honesty, which can be found with the link:

<http://ecatalog.calstatela.edu/content.php?catoid=25&navoid=2524> Regarding plagiarism, at Cal State LA, “plagiarism is defined 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 sources.” The work you or your team submit for this course must be from your own or your team’s scholarly and creative activities. When describe others’ work, you must give proper credit and citations.

**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. For more information visit the website <http://www.calstatela.edu/osd>.

**Dropping and Adding:**

Drop/Incomplete Policy will be strictly enforced. Check out the link <https://www.calstatela.edu/registrar/records-enrollment>

# **ASSIGNMENTS**

**Attendance:** Regular attendance and participation are required for both lecture and laboratory sessions.

**Exams:** There will be no make-up exams or assignments. Please inform your instructor should any special circumstances arise.

**Projects:**

**Project #1 – Sourdough Bread Project**

**Project #2 – Survey of Microbial Diversity Poster and One Sheet**

**Project #3 – Applied and Environmental Microbiology in the News Presentation**

**Laboratory Requirements:** Students must provide their own laboratory coat and permanent marker. These items can be purchased at the student bookstore or elsewhere. Laboratory attendance is required. Experiments build on prior experiments so when you miss class meetings you not only miss the content from that class meeting but you put yourself at a disadvantage for other class meetings.  **Laboratory reports will be announced in lab upon completion of the experiments.**

**Grading**

|  |  |
| --- | --- |
| **Projects** | **25%** |
| **In Class/Homework** | **25%** |
| Lecture Exams | 10% |
| Lecture Final | 10% |
| Lab Reports | 15% |
| Lab Midterm | 5% |
| Lab Final | 10% |
| **TOTAL** | **100%** |

**Final Course Grade:**

|  |  |
| --- | --- |
| **Percent of Total** | **Letter Grade** |
| 91-100 | A |
| 90-90.9 | A- |
| 89-89.9 | B+ |
| 82-88.9 | B |
| 80-81.9 | B- |
| 76-79.9 | C+ |
| 65-75.9 | C |
| 60-64.9 | C- |
| 55-59.9 | D |
| Below 55 | F |

**TENTATIVE LECTURE SCHEDULE… (modifications will be announced in class)**

|  |  |  |
| --- | --- | --- |
| **Week** | **Date** | **Topic** |
| **1** | 1/23 | General Course Information and Logistics |
| 1/25 | Introduction to Applied and Environmental Microbiology  *Bacteria and Archaea on Earth and their abundance in biofilms*  *(*Flemming and Wuertz *2019)* |
| **2** | 1/30 | Introduction to Applied and Environmental Microbiology (Continued) |
| 2/01 | Chemistry of the Cell |
| **3** | 2/06 | Methodology in Environmental Microbiology |
| 2/08 | Microbial Ecology and Interactions  *Animals in a bacterial world, a new imperative for the life sciences (McFall-Ngai 2013)* |
| **4** | 2/13 | Biofilms and Microbiomes  Biofilms: an emergent form of bacterial life *(Flemming 2016)*  *Human gut microbiome: hopes, threats and promises (Cani, 2018)* |
| 2/15 | Projects Introduced |
| **5** | 2/20 | The Environments  *Living at the Extremes: Extremophiles and the Limits of Life in a Planetary Context (Merino 2019)* |
| 2/22 | The Environments (Continued) |
| **6** | 2/27 | Exam #1 |
| 3/01 | Biogeochemical Cycling  *The Microbial Engines That Drive Earth’s Biogeochemical Cycles (Falkowski et al. 2008)* |
| **7** | 3/06 | Biogeochemical Cycling (Continued) |
| 3/08 | Microbial Metabolism |
| **8** | 3/13 | Microbial Ecology |
| 3/15 | Bioremediation  *Bioremediation of Metal Contamination (Lovley & Coates 1997)*  *Anaerobes to the Rescue (Lovley 2001)* |
| **9** | 3/20 | Project #2: Student Posters on Assigned Microbe (50 points) |
| 3/22 | Project #2: Student Posters on Assigned Microbe (50 points) |
|  | 3/27-3/31 | Spring Break |
| **10** | 4/03 | Exam #2 |
| 4/05 | Food Microbiology |
| **11** | 4/10 | Water & Wastewater  *Detection and Enumeration of Coliforms in Drinking Water: Current Methods and Emerging Approaches (Rompre et al. 2002)* |
| 4/12 | Industrial Microbiology  A Story About Vaccines  *Ileal-lympoid-nodular Hyperplasia, Non-Specific Colitis, and Pervasive Developmental Disorder in Children (Wakefield et al. 1998)*  *Autism and Measles, Mumps, and Rubella Vaccine: No Epidemiological Evidence for a Causal Association (Taylor et al. 1999)* |
| **12** | 4/17 | Aerobiology  *Aerobiology and its Role in the Transmission of Infectious Diseases (Fernstrom and Goldblatt 2013)* |
| 4/19 | Global Scale Perturbations |
| **13** | 4/24 | Astrobiology |
| 4/26 | Project #3, Student Presentations (100 points) |
| **14** | 5/01 | Project #3, Student Presentations (100 points) |
| 5/03 | Project #3, Student Presentations (100 points) |
| **15** | 5/8 | Project #3, Student Presentations (100 points) |
| 5/10 | Project #3, Student Presentations (100 points) |
| **Finals** | Date TBD | Cumulative Final Exam |

**Readings:**

1. Falkowski, Paul G., Tom Fenchel, and Edward F. Delong. "The microbial engines that drive Earth's biogeochemical cycles." *science* 320.5879 (2008): 1034-1039.
2. Lovley, Derek R. "Anaerobes to the rescue." *Science* 293.5534 (2001): 1444-1446.
3. Lovley, Derek R., and John D. Coates. "Bioremediation of metal contamination." *Current Opinion in Biotechnology* 8.3 (1997): 285-289.
4. Rompré, Annie, et al. "Detection and enumeration of coliforms in drinking water: current methods and emerging approaches." *Journal of microbiological methods* 49.1 (2002): 31-54.
5. Taylor, Brent, et al. "Autism and measles, mumps, and rubella vaccine: no epidemiological evidence for a causal association." *The Lancet* 353.9169 (1999): 2026-2029.
6. Wakefield, Andrew J., et al. "RETRACTED: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children." *The Lancet* 351.9103 (1998): 637-641.
7. Flemming and Wuertz 2019. Bacteria and archaea on Earth and their abundance in biofilms. Nature Reviews Microbiology. 17: 247-269.
8. McFall-Ngai, et al. 2013. Animals in a bacterial world, a new imperative for the life sciences. PNAS. Vol. 110(9): 3229-3236.
9. Flemming et al. 2016. Biofilms: an emergent form of bacterial life. Nature Reviews Microbiology. Vol 14.
10. Cani et al. 2018. Human gut microbiomes: hopes, threats and promises. Gut; **67**:1716-1725. Doi:10.1136/gutjnl-2018-316723.
11. Merino et al. 2019. Living at the Extremes: Extremophiles and the Limits of Life in a Planetary Context. Front. Microbiol. 10:780.
12. Fernstrom and Goldblatt 2013. Journal of Pathogens. **2013**:493960. Doi: 10.1155/2013/493960.

Reference books (there are not required textbooks for this class):

Pepper, I. L., Gerba, C. P., Gentry, T. J. 2015. Environmental Microbiology, 3rd ed. Academic Press, Waltham, MA.

Madsen, Eugene L. 2016. Environmental Microbiology: from Genomes to Biogeochemistry. 2nd ed. John Wiley & Sons, Inc., Hoboken, New Jersey.

**LAB SCHEDULE:**

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| --- | --- | --- |
| **Week** | **Date** | **Lab Exercises** |
| 1 | 1/23 or 1/25 | Lab 11 - Kitchen Counter Petrifilm Study, an overview; Project 1, Sourdough Bread Project, an overview; and discuss safety; |
| 2 | 1/30 or 2/01 | Lab 11 - Kitchen Counter Petrifilm Study, continued; Project 1, Sourdough Bread Project, continue discussion; |
| 3 | 2/06 or 2/08 | Discuss lab safety; discuss serial dilutions, soil sampling, and DNA extractions |
| 4 | 2/13 or 2/15 | Lab 1 - Serial Dilutions; |
| 5 | 2/20 or 2/22 | Lab 2 - Soil Sampling  Lab 1 - Serial Dilutions Cont’d  Lab 3 - Contact Slide |
| 6 | 2/27 or 3/01 | Lab 3 - Contact Slide Cont’d  Lab 8 - Soil DNA Extraction  Lab 4A - Soil Enumeration |
| 7 | 3/06 or 3/08 | Lab 4A - Soil Enumeration Cont’d  Lab 9 – Soil 16S rRNA gene PCR |
| 8 | 3/15 or 3/17 | Lab 9 – Soil 16S rRNA gene PCR Cont’d  Bioinformatics module discussion |
| 9 | 3/20 or 3/22 | **Midterm**  Lab 6 - Bacterial Examination of Water |
|  | 3/27-3/31 | Spring Break |
| 10 | 4/03 or 4/05 | Lab 4B - Soil Unknown (BIOLOG)  Lab 6 - Bacterial Examination of Water Cont’d |
| 11 | 4/10 or 4/12 | Lab 4B - Soil Unknown Cont’d (BIOLOG)  Lab 5 - Aerobiology |
| 12 | 4/17 or 4/19 | **Lab activities cancelled for class fieldtrip:**  **Ocean sediment coring expedition: San Pedro, CA.**  Plan B:  Lab 4B - Soil Unknown Cont’d (BIOLOG)  Lab 5 – Aerobiology, Cont’d |
| 13 | 4/24 or 4/26 | Lab 4B - Soil Unknown Cont’d (BIOLOG)  Lab12- Bioinformatics: Metagenomics module |
| 14 | 5/01 or 5/03 | Lab12- Bioinformatics: Metagenomics module Cont’d  **Final Exam Review** |
| 15 | 5/08 or 5/10 | **Cumulative Final Exam** |