NTM CURE – Sample syllabus

Credits: 4 credits
Meeting time: 3 hours two times a week

Course description: You will be actively engaged in hypothesis-driven research to investigate how climate affects the Non-Tuberculous Mycobacteria (NTM) communities of environmental samples such as soil and water. The course will focus on NTM diversity and physiology and its relationship with climate.

Community guidelines: The first day of class we will come up with community guidelines and expectations as a group. Here are a few to get started:

1. Treat each other with respect
2. All problems can be solved with the right attitude
3. Everybody has the potential to become a great scientist
4. Everybody will contribute to maintain the lab in a clean and organized space

Diversity, Equity, and Inclusion: I welcome and appreciate students from all diverse backgrounds and perspectives, and I will make every intention to serve all students’ learning needs impacted from conditions in or out of class. Diversity of experiences and thought will be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity, including but not limited to: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions and feedback are encouraged and appreciated. Please let me know ways where I can make this learning experience more impactful for you personally or for other students or student groups.

Special Needs: Institute specific

Attendance:

It is in your best interest to attend all lab sessions. As a matter of respect to your peers and instructor, and also to help you complete all lab activities for your research, it is expected you will be on time. I understand sometimes life gets on the way and there may be times where you may have to miss a lab session. If that is the case, I expect you to communicate in advance (within 24 hours before the missing session) so that we can come up with a plan for you to make up the missed session.

Outside of scheduled contact time

At least 2 hours of outside effort for every contact hour (credit) may be required for you to complete all assignments and stay up to date on your research. There may be times that you may need to come in the lab outside of regular hours to complete activities that cannot fit in the scheduled time. There may be activities that will require you to come in before the schedule time or to stay after the schedule time. I will communicate in advance when this may happen. If you have other commitments before or after the schedule time (i.e. another class, work, caring for a family member) please let me know so we can identify an alternative option.
Specific Research Goals:

You will have the opportunity to develop your own research goals, however, it is expected that by the end of this course you will be able to:

1. Characterize water and soil microbial communities by analyzing their diversity and abundance during two different climate seasons.
2. Compare and contrast abundance and diversity of culturable mycobacteria vs 16S metagenomics.
3. Isolate and characterize NTM from environmental samples.
4. Analyze the presence and diversity of NTMs in relation to climate variables.

Course Learning Goals:

At the end of this course, you will be able to:

1. Apply the scientific method to formulate and test a hypothesis for a specific research problem.
2. Demonstrate reasoning and troubleshooting skills when conducting experiments and analyzing data.
3. Develop team-work by effectively participating and analyzing data in small groups of individuals of different backgrounds.
4. Apply good laboratory practices and note taking.
5. Be proactive in your research and utilize critical thinking skills.
6. Synthesize scientific literature and write protocols to apply to your research.

Academic integrity
Institute specific

Assessments and Grading:

Final grades will be traditional letter grades (A > 90%, B = 80-89%, C = 70-79%, D = 60-69%, F < 60%) and will be based on: Quality of laboratory notebooks (20%), Assignments (30%), Professional behavior (10%), final written project in the form of a poster (20%), and final oral poster presentation (20%).

Lab notebooks (20% of the total grade): You will maintain your own laboratory notebook. The notebook can be digital or paper based. We will discuss the pros and cons of each of them the first day of class and we will decide as a group which one to use. The grade assigned for lab notebooks will be based on the rubric posted on Canvas. Lab notebooks will be reviewed on a weekly basis (we will determine as a group which day of the week the notebooks will be due for grading).

Assignments (30% of the total grade): There will be 1-2 assignments per week. Most assignments will be worth 2 points. Most (but not all) assignments will be submitted via CANVAS. These assignments will be diverse in nature and may include the following:

1. Review of research articles
2. Calculations (i.e. concentrations (Molarity, percentage), dilutions, etc)
3. Analysis of the data and results generated from your research
4. Drafting protocols as a group or individually
5. Providing drafts of poster sections and a final draft before your presentation

All assignments are designed to provide you with a true research experience and help you gain or strengthen the skills you will need as a scientist. I will provide feedback within 2 days after the assignment is due. Please know all the feedback I provide is intended to help you succeed as a scientist!

It is expected all assignments will be submitted by the due date. We will discuss as a group, an appropriate point reduction for every day the assignment is late.

Professionalism (10% of the total grade): It is expected that you will behave as a professional scientist: arriving on time and attending all lab sessions is a requirement. In addition, it is expected you will be a team player by maintaining your bench and common areas clean and organized; and sharing your data for other students to review in a shared google sheet file at least 2 times during the semester. We will discuss as a group what professionalism means to you and will create norms and expectations as a group for everybody to follow.

Final poster presentation: (40% of the total grade, graded as 20% for the poster preparation and 20% for the oral presentation): You will prepare and present a poster of your research at the end of the semester. You can use PowerPoint, Adobe Illustrator, or other software to construct the poster. The goals of the poster presentation is to prepare you to communicate science, to give you the opportunity to share your research with others and to assess your understanding of the research you completed during the semester. The grade for the poster presentation will be based on the rubric that will be posted in Canvas and discussed prior to the construction and presentation of the poster.

Lab Safety Guidelines
1. Ask before you act (Always Ask Questions).
2. No food, beverages, smoking, or cosmetic (makeup) application is allowed in the lab.
3. Lab coat and closed-toe shoes are required at all times while inside the lab. Shorts or skirts are not permitted, eye protection and gloves are required.
4. Notify instructor of any injuries or broken glass immediately.
5. Do not trust that the bench top is a clean surface. Decontaminate before and after use.
6. Do not contaminate notebooks and writing utensils. Remove gloves before handling.
7. Only registered students are allowed in the laboratory.
8. Cell phones should not be used in the laboratory unless properly protected from the laboratory environment.

Learning Resources:
The syllabus, primary literature, presentations, papers, web links, and all assignments will be
provided to you. You will need Microsoft Word and Adobe Acrobat on your computer to view most of the files and presentations. Please let me know if you need assistance.

Required resources (protocols, recent review articles, primary research, etc.) that are relevant to the topic for each session will be provided in advance. These articles will be provided to you.

You will need to use resources such as Pubmed or google Scholar to identify relevant scientific literature.
Example of the NTM CURE Schedule. Each week has 6 hours (2 days, 2 hours each) of lab work.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Aug 23</td>
<td><strong>Introductions</strong>&lt;br&gt;- Overview of Syllabus.&lt;br&gt;- Course expectations.&lt;br&gt;- Overview of poster production.&lt;br&gt;- Outlining of database for environmental variables and samples.</td>
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<td><strong>Review of previous years research goals</strong>&lt;br&gt;- Introduction to previous years questions and data&lt;br&gt;- Overview of biosafety levels&lt;br&gt;- How to keep a proper notebook.</td>
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<td>2</td>
<td>Aug 30</td>
<td><strong>NTM culture from the environment:</strong>&lt;br&gt;Review of literature and identifying research questions (Team work)&lt;br&gt;<strong>General laboratory housekeeping</strong>&lt;br&gt;- How to use the autoclave.&lt;br&gt;- Media preparation.&lt;br&gt;- Setting up PBS and water sterile aliquots</td>
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<td>3</td>
<td>Sep 6</td>
<td><strong>Environmental sampling and culture - soil</strong>&lt;br&gt;- Overview of environmental sampling and record keeping.&lt;br&gt;- Pipetting basics.&lt;br&gt;- Sample processing (decon and culture).&lt;br&gt;- Plating of samples</td>
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<td>4</td>
<td>Sep 13</td>
<td><strong>Environmental sampling and culture - water</strong>&lt;br&gt;- Sample processing (decon and culture).&lt;br&gt;- Plating of samples</td>
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<td><strong>DNA extraction of soil and water samples</strong>&lt;br&gt;- Review of literature and protocol writing (Team work)</td>
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<td>5</td>
<td>Sep 20</td>
<td><strong>DNA Quality control</strong>&lt;br&gt;- DNA quantification – Nanodrop&lt;br&gt;- Agarose gel electrophoresis&lt;br&gt;<strong>Preparation of unique colonies from samples</strong>&lt;br&gt;- Training on Biosafety Cabinet use&lt;br&gt;- Laboratory aseptic technique and 3-way streak method of bacterial isolation&lt;br&gt;- Streak for isolation&lt;br&gt;<strong>How to make a freezer stock and maintain a bacterial strain list</strong></td>
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<td>6</td>
<td>Sep 27</td>
<td>Floating week (use to catch up on activities)</td>
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<td>7</td>
<td>Oct 4</td>
<td><strong>Identification of isolated colonies</strong>&lt;br&gt;Microscopy (Gram and acid fast staining)&lt;br&gt;DNA extraction from colonies&lt;br&gt;Overview of 16S rDNA sequencing and specie identification by hsp65 and 16S rDNA</td>
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| Week 8  | Oct 11 | PCR - 16S and hsp65 for colony ID via sanger sequencing  
|         |        | Decon and culture of soil sample #2 |
| Week 9  | Oct 18 | Decon and culture of water sample #2  
|         |        | DNA extraction of soil and water samples #2 |
| Week 10 | Oct 25 | Preparation of samples for 16S Illumina sequencing  
|         |        | - Library preparation of 16S rDNA – PCR Round 1  
|         |        | - Library quality control (agarose gel electrophoresis) for PCR round 1 |
| Week 11 | Nov 1  | - Streak for isolation of new colonies  
|         |        | - Complete any other activities as needed |
| Week 12 | Nov 8  | - DNA extraction of new colonies  
|         |        | - PCR for sanger sequencing of new colonies |
| Week 13 | Nov 15 | Catching up on colony microscopy, DNA extraction and PCR for colony ID for all slow growing colonies. |
| Week 14 | Nov 22 | HAPPY THANKSGIVING!! |
| Week 15 | Nov 29 | Tutorial Data analysis of 16S NGS  
|         |        | Poster preparation |
| Week 16 | Dec 6  | Tutorial Data analysis of 16S NGS  
|         |        | Poster preparation |
| Week 17 | Dec 13 | Poster presentations |

Schedule is subject to change to accommodate discovery and hypothesis-driven research. The course instructor reserves the right to change topics or adjust the schedule as the semester progresses. Notification of changes will be given to the class via announcement in class and postings in Canvas [http://info.canvas.colostate.edu/login.aspx](http://info.canvas.colostate.edu/login.aspx).

**Important information on COVID-19:**

All students are required to follow public health guidelines in any university space, and are encouraged to continue these practices when off-campus(es). Students also are required to report any COVID-19 symptoms to the university immediately, as well as if they have potentially been exposed or have tested positive at a non-CSU testing location. If you suspect you have symptoms, please fill out the COVID Reporter [https://covid.colostate.edu/reporter/](https://covid.colostate.edu/reporter/). If you have COVID symptoms or know or believe you have been exposed, it is important for the health of yourself and others that you complete the online COVID Reporter. Do not ask your instructor to report for you; if you report to your instructor that you will not attend class due to symptoms or a potential exposure,
you are required to also submit those concerns through the COVID Reporter. If you do not have access to the internet to fill out the online COVID-19 Reporter, please call (970)491-4600.

For the latest information about the University’s COVID resources and information, please visit the CSU COVID-19 site [https://covidrecovery.colostate.edu/](https://covidrecovery.colostate.edu/)

**COVID-19 Safety guidelines specific to this course**

1. Face covering will be required at all times while in the lab. You are encouraged to keep a face covering in the lab to only be used while inside the lab (this is to reduce potential contamination with NTMs outside the lab)
2. You will be assigned to a bench. It is expected you will sanitize the bench surface before and after each lab.