

BMB 961 Section 001 –Cryo Electron Microscopy of Biological Samples Laboratory

Class Meetings

In Person

Lectures Monday 1-1:50 pm

Hands on laboratory training: TBD (schedule on your own with the instructors)

Instructors

Course Coordinator

Dr. Kristin Parent (she/her)

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Dr. Sundharraman (“Sundhar”) Subramanian (he/him)

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**Office hours will be by individual appointment

There are two components to this course: lectures and hands on laboratories.

Lecture Schedule (Mondays 1-1:50pm)

Module	Week of	topic	Instructor
1	1-Sept	No in person class—there will be an intro video to watch on D2l	KP
2	6-Sept	Tour of the Microscope Facility, Basic microscope construction and lens theory	KP
3	13-Sept	How cryo-EM images are formed	KP
4	20-Sept	Sample and grid preparation (negative stain and vitrification)	KP
5	27-Sept	Basics of microscope alignment	KP
6	4-Oct	Midterm Exam	KP
7	11-Oct	Setting up an EPU session and “low dose” theory (SPA)	Sundhar
8	18-Oct	Setting up an EPU session (tomography)	Sundhar
9	25-Oct	No lecture	N/A
10	1-Nov	No lecture	N/A
11	8-Nov	No lecture	N/A
12	15-Nov	No lecture	N/A
13	22-Nov	No lecture	N/A
14	29-Nov	No lecture	N/A
15	6-Dec	Presentations (Monday) and Practical Exams (TBD; individual practicals will be scheduled)	N/A

****Lab times will be by appointment with the Instructor and may either be one on one, or in groups of two**

Laboratory Schedule

Module	Week of	topic	Instructor	Lab time*
1	1-Sept	No laboratory this week		TBD
2	6-Sept	Basic imaging of negative stain samples, moving the stage and finding samples, magnification consideration and focusing	KP	TBD
3	13-Sept	Grid preparation (glow discharge and negative stain)	KP	TBD
4	20-Sept	Grid preparation (vitrification)	KP	TBD
5	27-Sept	Grid clipping and loading the autoloader	KP	TBD
6	4-Oct	EPU setup and data collection (SPA)	Sundhar	TBD
7	11-Oct	EPU setup and data collection (Tomography)	Sundhar	TBD
8	18-Oct	Individual Student Projects	Sundhar	TBD
9	25-Oct**	Individual Student Projects	N/A	TBD
10	1-Nov	Individual Student Projects	N/A	TBD
11	8-Nov	Individual Student Projects	N/A	TBD
12	15-Nov	Individual Student Projects	N/A	TBD
13	22-Nov	Individual Student Projects	N/A	TBD
14	29-Nov	Individual Student Projects	N/A	TBD
15	6-Dec	Practical Exams	Sundhar/KP	TBD

**** October 25 and 26 are University holidays. You will need to plan accordingly that week.**

Course Description

This is a hands-on, course dealing with several aspects of cryo-electron microscopy (cryo-EM). We will start with an overview of electron microscopes and optics, and provide hands on experience in imaging biological specimens. We will go through some of the most commonly used protocols for negatively staining protein samples, vitrification of biological material, as well as grid clipping and loading into a modern Talos Arctica microscope. Then we will go through the process of setting up a high throughput and high-resolution cryo-EM data collection sessions including both single particle analysis and cryo-electron tomography applications. Lectures will cover the theory and demonstrate the methods used; lab hours will provide hands-on experiences. The first portion of the course will make use of known “standards”. The second half of the course will involve student-driven research projects of their choosing.

Inclusion in BMB 961

It is our intention that this class is a safe and productive learning environment for every person. However, we recognize that inclusion is a complex issue and we still have much to learn about and from the diverse backgrounds and perspectives of students. If actions of the instructional team or other students make you feel uncomfortable, please let us know and we will do our best to correct the situation. If you do not feel comfortable discussing this directly, you can reach us through your academic advisor, another student, or another avenue that is more comfortable.

Grades

Your grade in BMB 961 is based on a 4.0 scale. The following components shows the composition of the course and what you must achieve to guarantee a passing grade.

Assessment Type	%	Notes
Midterm Exam	(20%)	This will be a written exam, "open notes"
Presentation/Progress of Individual Project	(30%)	Based on how well you have progressed (troubleshooting and improving grid prep and data collection)
Practical Exam	(50%)	This is critical as you will become a certified user of the facility after the course ends

Grade**	%
4.0	>89%
3.5	>82%
3.0	>74%
2.5	>68%
2.0	>61%
1.5	>55%
1.0	>49%
0.0	≤49%

**** The expectation is that students that have successfully completed this course will obtain "user A" status and be independent in the RTSF Cryo-EM facility. A minimum grade of 3.5 in this course is required to obtain this status.**

Required Course Materials –

1. Textbook : There is **no** textbook assigned for this course. I will make online resources available and suggest books for those who wish for additional content. However we will not use these directly in the course.

Lecture notes will be provided through D2L. These are lecture notes largely designed by Dr. Timothy S. Baker at the University of California, San Diego (those ones labeled as “CHM 165,265/BIMM 162/BGGN 262”), as well as some of my own custom design.

3. D2L and Email

We will make announcements by D2L e-mail. Course materials including study aids and grades will be posted on D2L. Questions regarding grades, course mechanics, or of a personal nature should be sent by e-mail directly to Dr. Parent from your MSU email account (other email accounts may be marked as spam). You can expect responses to email communication within 2 business days.

Assessments

1. Mid Term Exam (20%)

- Exams will have a mixture of multiple choice and free response questions.
- Exams are individual efforts and you should neither give nor receive help during exams, although we will allow you to refer to your notes.

2. Presentation / Progress of Individual Project (30%):

- Each student will either pick a sample provided by Sundhar for their individual project, or if students are using cryo-EM as part of their research, this can be their own sample. This could be **EITHER** a project on single particle data collection, **OR** tomography.
- Students will have the entire second half of the semester to demonstrate negative staining/vitrification and data collection on their sample. It is the responsibility of the student to co-ordinate and plan their experiments in accordance with the facility schedule.
- Each student will prepare and give a 10 minute presentation to the class using power point (or other), to present their independent project.

2. Practical Exam (50%):

- Each student will need to demonstrate competency in the following procedures:
- Grid handling
- Glow discharging
- Vitrification
- Grid clipping
- Grid Storage
- Basics of microscope operation (basic alignments, changing magnification, focusing, finding a sample, and setting up routine imaging)

4. Extra credit

- There is no extra credit for this course.

Attendance and Absences

We will not allow any excused absences from lecture, or scheduled one-on-one training. All laboratory training must be completed by 5 pm of the Friday of each week in order to be considered completed “on time”.

If you unexpectedly miss a lecture due to extenuating circumstances, or need to reschedule your training you *must* contact either Dr. Parent or Dr. Subramanian. It is your responsibility to provide adequate documentation of the extenuating circumstance. You may or may not be eligible for a makeup assignment at the discretion of the instructional team. Make-up assignments are administered at the instructor's convenience.

Academic Integrity/Cheating Policy

According to the MSU policy on the integrity of scholarship and grades, "The principles of truth and honesty are fundamental to the educational process and the academic integrity of the University". Every student should be familiar with this policy (<https://www.msu.edu/unit/ombud/academic-integrity/index.html>). All students have a right to expect fair and honest evaluation of their work. Cheating undermines this expectation and will not be tolerated. Any student found by the instructors to be cheating will receive a failing grade for the exam or other graded work and be reported to the Dean. The instructors may, at their discretion, decide to give a failing grade for the course in severe, repeat, or egregious cases of academic dishonesty. Please hold yourself, and your classmates, to the highest ethical standards in this regard!

Accommodations for Persons with Disabilities

Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at www.rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to Dr. Parent at the start of the term or two weeks prior to the first accommodation date. Requests received after this date may not be honored.