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)

Instructor

Course Coordinator

Dr. Kristin Parent (she/her)

E-mail: kparent@msu.edu

Phone: (517) 432-843

Office: 519A Biochemistry

**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
1	26-Aug	Tour of the Microscope Facility, on D2l –Open House 10-4 (come anytime you can)
2	1-Sept	No class—Labor Day; course overview —there will be an online video to watch
3	8-Sept	Basic microscope construction and lens theory
4	15-Sept	How cryo-EM images are formed
5	22-Sept	Sample and grid preparation (negative stain and vitrification)
6	29-Sept	Basics of microscope alignment
7	6-Oct	Image Quality and Analysis, Radiation Damage
8	13-Oct	Midterm Exam
9	8-Dec	Presentations (Monday) and Practical Exams (TBD; individual practical exams will be scheduled)

Homework Schedule

Module	Due Date (before 5:00 pm)
1	12-Sept
2	19-Sept
3	26-Sept
4	3-Oct
5	10-Oct

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	28-Aug	Tour of facility etc (Open House)	KP	Mon 1-2
2	1-Sept	Grid preparation (handling, glow discharge and negative stain)	KP	TBD
3	8-Sept	Grid preparation (vitrification)	KP	TBD
4	15-Sept	Grid clipping and loading the autoloader	KP	TBD
5	22-Sept	Basic imaging, moving the stage and finding samples, magnification consideration and focusing	KP	TBD
6	29-Sept	Basic imaging, moving the stage and finding samples, magnification consideration and focusing cont'd	NA	TBD
7	6-Oct	Basic imaging, moving the stage and finding samples, magnification consideration and focusing cont'd	NA	TBD
8	13-Oct	NO Sessions (break after mideterm)	NA	TBD
9	20-Oct**	Individual Student Projects	N/A	TBD
10	27-Oct	Individual Student Projects	N/A	TBD
11	3-Nov	Individual Student Projects	N/A	TBD
12	10-Nov	Individual Student Projects	N/A	TBD
13	17-Nov	Individual Student Projects	N/A	TBD
14	24-Nov***	Individual Student Projects	N/A	TBD
15	8-Dec	Presentations & Practical Exams	Sundhar/KP	TBD

***** October 20 and 21 are University holidays. You will need to plan accordingly that week.***

****** The week of Nov 24th is Thanksgiving. 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 experiences 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.

Required Course Materials

1. Textbook

- There is no specific text book for this course.
- All course-specific lecture notes will be made available through D2L.
- In addition there will be videos—pre recorded lectures and some YouTube videos. Links will be made available through D2L.

2. D2L and Email

We will make announcements either in class ***or*** 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 or Dr. Subramanian 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. Homework (10%)

- Homework will be a series of "check your understanding" questions and will cover topics from pre-recorded lectures/YouTube videos/ and the reading.
- Homework will typically consist of five to ten questions per week.

2. Examinations (60% total)

Midterm--written (20%)

- The midterm exam will have a mixture of multiple choice, free response, label the figure, true/false questions.
- Exams are individual efforts and you should neither give nor receive help during exams.

Final—practical (40%):

- Each student will be asked to demonstrate the following ***within 2 hours*** (independently with no instructor help)
- Negative stain
- Grid clipping (under liquid nitrogen)
- Eucentric height correction
- Navigation to a good area on a grid and taking a high resolution image at high magnification with correct focus

3. Presentations (30%)

We will do this during the class period on Monday Dec 12th (either in person or via zoom). Each student will present for 10 min including:

- Background of their projects (what is your protein and why are you using cryo-EM to study it)
- Initial assessment (negative staining and results)
- Progression (cryo data, or more negative stain as the case may be)
- Future plans

Attendance and Absences

Missing class counts as an absence. This includes religious commitments, other MSU activities, and illness. Since this is a hands on course, **all absences will need to be rescheduled and the course content will need to be completed**. Missing any module of the course without making up the time will result in an incomplete grade for the semester.

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***
Homework	10%	Weekly "check your understanding" questions in D2L
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	(40%)	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.***