Syllabus

BCMB 562: Introduction to Electron Microscopy of Biological Samples

Spring 2017 Tuesday + Thursday 9:40 – 10:55 a.m. Walters Life Sciences M401

Instructors

Andreas Nebenführ Hesler Biology 240 nebenfuehr@utk.edu John Dunlap Science and Engineering Research Facility 101 jrdunlap@ utk.edu

Office Hours: Contact instructor by email.

Recommended Texts

Electron microscopy: principles and techniques for biologists John J. Bozzola Lonnie Dee Russell (NetLibrary, Inc.) *This book is on reserve in Hodges Library for 2 hour checkout.*

2. Biological electron microscopy : theory, techniques, and troubleshooting Michael J. Dykstra (New York : Plenum Press c1992)

3. Physical Principles of Electron Microscopy : An Introduction to TEM, SEM, and AEM Ray F. Egerton (Boston, MA : Springer Science+Business Media, Inc. 2005) *This book is available as a PDF file on the Canvas course site.*

Other relevant books can be found in Hodges Library in sections QH207, QH212.E4, QH212 S3, and QH212.T7.

Learning Outcome: Students will learn the scientific rationale and principles of electron microscopy applied to biological samples through formal lectures. Students will also gain basic skills for preparing samples and use of the TEM or SEM for sample analysis. These theoretical considerations and practical skills feed directly into the broader BCMB graduate program learner outcome of designing, executing, analyzing, and interpreting scientific experiments.

Course description: This course will introduce students with an important skill in modern cell biology: Transmission and scanning electron microscopy. The course is divided into four sections, A through D. Sections A - C will be covered in the first eight weeks of the course. The focus of Section A is sample preparation, that of section B is the theory behind the TEM and SEM and their operation, and C addresses applications

of TEM and how to critique an electron micrograph. The second half of the course, Section D, is dedicated to individual student projects. Note that during these times instructors will be available for guidance and will work with students in the lab. However, students are expected to work on their project outside the regular class sessions as needed.

The purpose of this course is two-fold. The first is to teach the scientific rationale and principles behind the handling and preparation of biological samples for subsequent viewing under a TEM or SEM. The second is to provide the opportunity for hands-on training and supervision of those techniques in the lab, and to afford students the opportunity to become familiar with the microscope.

The theoretical component of the course will be delivered primarily through traditional lectures. A list of recommended texts is provided at the beginning of this document. The practical component will be carried out almost exclusively in the Electron Microscopy facilities in SERF or in the JIAM building and managed by Dr. Dunlap.

At the end of the course you will be able to determine the most suitable approach for preparing your sample of interest for imaging by TEM or SEM. You will also gain a basic understanding of how an EM works, and the variety of uses for the instrument. Finally, you will have learnt how use a variety of peripheral instruments in the EM prep lab and will identify areas where you will seek further training.

Course Schedule

- 01/12 Introduction and Overview
- 01/17 A1: Fixation
- 01/19 A2: Dehydration
- 01/24 A3: Embedding
- 01/26 A4: Staining and Ultramicrotomy
- 01/31 A5: Lab Demo: High Pressure Freezing
- 02/02 A6: Selecting the "Best" Procedure
- 02/07 D1: Consultation on Individual Projects
- 02/09 D2: Radiation Safety Training
- 02/14 B1: Introduction to Électron Optics
- 02/16 B2: Physics of Electron Optics
- 02/21 B3: Parts of the TEM
- 02/23 B4: Analytical EM (STEM, SEM, DS, EELS, ESI)
- 02/28 C1: Cryotechniques
- 03/02 C2: Immunohistochemistry and Tomography
- 03/07 C3: Image Analysis
- 03/09 D3: TEM demonstration
- 03/14 Spring Break
- 03/16 Spring Break
- 03/21 D4: Individual Project: Lab Safety

- 03/23 D5: Individual Project
- 03/28 D6: Individual Project
- 03/30 D7: Individual Project
- 04/04 D8: Individual Project
- 04/06 D9: Individual Project
- 04/11 D10: Individual Project
- 04/13 D11: Individual Project
- 04/18 D12: Beam Time
- 04/20 D13: Beam Time
- 04/25 D14: Beam Time
- 04/27 In-class Presentations (and final project due)

Assignments

- 1. Class participation in lectures and in lab (25% of grade)
- 2. Take-home exam, long answer questions (25% of grade)
- 3. Short (~5 minute) presentation to class on 4/27 (25% of grade)
- 4. Written Report (due on Study Day, May 1) (25% of grade)
- The written report should consist of the following elements: (1) Introduction to the biological problem and formulation of the goal of the project. (2) Rationale for the selection of the chosen techniques. (3) Detailed description of methods used to prepare, image, and analyze samples. (4) Description of results, including images and their analysis. (5) Discussion of results, conclusions from analysis, and suggestions for future work. (6) List of relevant references.

Grading

A: 200- 175 A-: 174-165 B+: 164-155 B: 154-140 B-: 139-130 C+:129-120 C: 119-105 F: 104 and below

Make-up and Late Assignment Policy: Acceptance of late assignments and make-up exercises will be at the discretion of the instructors upon receiving a written request containing an explanation for the missed assignment. Any request should be handed in at the earliest possible time.

Changes to Syllabus: Any changes to this syllabus will be announced by e-mail and posted to Canvas. <u>Students are responsible for monitoring their UTK e-mail accounts and the course Canvas site.</u>

Course Announcements: Any announcements about the course will be sent by e-mail and posted to Canvas.

Policies on Cheating and the UT Student Pledge: Projects are expected to be entirely original. Any instance of copying material (text or figures) from a published source or from another student's project will be considered cheating. Cheating on projects is forbidden and will result in a grade of F on the exam or project, referral to Student Judicial Affairs, the possibility of expulsion from class and other disciplinary action from the University. Students are also expected to abide by the UT Student Pledge as stated in Hilltopics and deviations from this are also likely to result in disciplinary action.

Disability Statement: If you need special course adaptations of accommodations because of a documented disability, please contact the office of Disability Services at 974-6087 to ensure that you get the necessary resources.