Fluorescence and Electron Microscopy: Imaging Cells and Molecules
GS04 1051 - 100 (7704); Mondays, 1-2pm (lectures*), 2-4pm (labs)

Course Directors:  
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TAs:  
Kara Schoenemann/Davi Goncalves(FM)  
Xiangan Liu(EM)

Week 1 (1/06/2020)
Lecture: Principles of Light Microscopy, MSB 1.180  
Morano  
• Optics (physics and practice)  
• Introduction to microscopy: brightfield, darkfield, DIC, fluorescence

Week 2 (1/13/20)
Lecture: Hardware and Equipment, MSB 1.180  
Morano  
• Understanding objectives, mirrors, lightpaths  
• Widefield, confocal, spinning disk  
• Cameras  
• Automation and computer control

Lab: Preparation of samples and light microscopy, MSB 1.022  
Morano and Margolin

MLK Holiday (1/20/20)

Week 3 (1/27/20)
Lecture: Whole Cell Imaging, MSB 1.180  
Margolin  
• Live cell imaging with fluorescent proteins and stains  
• Longitudinal imaging: media support and microfluidics  
• Fixed cell imaging: stains, indirect immunofluorescence

Lab: Live cell imaging, time-lapse imaging, & Immunofluorescence, MSB 1.022  
Morano and Margolin
**Week 4 (2/03/20)**

**Lecture: New Technologies, MSB 1.180**
- Margolin
  - FRET, two-photon, TIRF
  - Single molecule and super-resolution methods (SIM, PALM, STORM, STED)

**Lab: Super-resolution fluorescence microscopy, MSB 4.202**
- Levental, Margolin

**Week 5 (2/10/20)**

**Lecture: Image Post-Processing, MSB 1.180**
- Margolin
  - Deconvolution techniques and principles
  - Kymographs, time-lapse and overlays
  - Data analysis, quantitation, and management

**Presidents’ Day (2/17/20)**

**Week 6 (2/24/20)**

**Lecture: Introduction to Electron Microscopy, MSB 1.180**
- Tsai
  - Transmission electron microscopy (TEM)
  - Sample preparation and staining

**Lab: Operational principles of TEM, MSB 2.221M**
- Tsai

**Week 7 (3/02/20)**

**Lab: Specimen Preparation for TEM, MSB 1.022**
- Tsai
Immuno-gold labeling of biological samples and negative staining

**Week 8 (3/09/20)**

**Lab: TEM – Operation and Data Collection, MSB 2.221M**
- Tsai
Operating a transmission electron microscope and data collecting using previously prepared samples

**Spring Break (3/16 – 3/20/20)**

**Week 9 (3/23/20)**

**Lecture: Cryo-electron microscopy, MSB 1.180**
- Hu
  - Cryo-electron microscopy (cryo-EM)
  - Cryo-electron tomography (cryo-ET)

**Lab: Preparation of biological samples for cryo-EM, MSB G.606**
- Hu

**Week 10 (3/30/20)**

**Lecture: Cryo-EM – Operation and Data Collection, MSB 1.180**
- Hu
Operating a cryo-electron microscope and data collecting using previously prepared samples
Lab: Cryo-EM – Operation and Data Collection, MSB G.606  
Hu

**Week 11 (4/06/20)**

Lecture: Cryo-EM – Image Processing, MSB 1.180  
Hu
Basic image analysis: from 2D images to 3D reconstruction

Lab: Cryo-EM – Image Processing, MSB 1.180  
Hu

**Week 12 (4/13/20)**

Lecture* (2 hours): Electron Cryomicroscopy, MSB 1.180  
Serysheva
Vitrification of Biological Samples
Lab: Specimen preparation for cryo-EM, MSB 6.630  
Serysheva

**Grading**  
Pass/Fail
The total grade is based on attendance (20%), lab participation (50%), and three assignments (10% each).

**Assignments:** Students will write Materials & Methods and Results Sections accompanied with a publishable multi-panel figure and a figure legend corresponding to data obtained from each section, i.e. fluorescence microscopy (Margolin and Morano), electron microscopy (Tsai), and cryo-EM (Hu and Serysheva).

**Reading Materials**
Students are encouraged to read reading materials, provided by instructors, before class.

**Assignment Due Dates:** pdf documents sent to Bo.Hu@uth.tmc.edu on the due dates (see below)

2/24/20  Assignment 1
3/23/20  Assignment 2
5/06/20  Assignment 3