**Brightfield and Fluorescence microscopies for Field Biology Research**

Highlands Biological Station

July 28th – August 1st, 2025

Robert T. Youker, Ph.D.



*Rotifer – darkfield from Motic microscope website*

**I’ve always been attracted to colors. Color helps make the work more interesting and endurable. It helps when things aren’t going well. If I had been born colorblind, I probably never would have gone into this.**

**—** Roger Tsien (*Scientist reflecting on Nobel Prize 2008, UCSD*)

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**I. Rationale/Purpose**

This course provides hands on training in the use of brightfield and fluorescence microscopes. Students will learn the basic operation of a microscope, the scientific theories underlying image formation, and preparation of specimens to obtain high quality digital images. This course is intended for science students who wish to use brightfield and fluorescence microscopic techniques in their field research. Subjects covered include function of microscope components, theory of image formation, specimen preparation, image acquisition and image analysis. No prior experience in the use of microscopes is needed to take the course.

**II. Course Aims and Objectives:**

*By the end of this course, students will be able to:*

1. understand and demonstrate the function of basic microscope components.
2. understand how microscopes form images.
3. prepare specimens for brightfield and fluorescence microscopies.
4. acquire images using a brightfield or fluorescence microscope.
5. perform basic image analysis techniques.

**III. Course Materials**

*Course readings:*

* *Fundamentals of light microscopy and electronic imaging* by Murphy and Davidson (2nd edition)

[**Link to Proquest eBook Central**](https://ebookcentral.proquest.com/lib/hunter-ebooks/detail.action?docID=918267)

* Handouts (supplied by teacher)
* Canvas (website for quizzes, Homework, additional readings, etc.)

*For hands on activities/lab:*

* Bound Notebook or binder, Personal Laptop Computer (no chrome book please), Goggles/Safety glasses, Closed toe/heel shoes

**IV. Tentative Schedules**

*May change due to time constraints or accommodate inclement weather.*

Readings, and other information will be provided in class and online.

**Lecture Topic Schedule (Mornings)**

|  |  |  |
| --- | --- | --- |
| Day | Topics | Assignments |
| 1 (July 28) | Introduction to course, anatomy of a microscope,  & Types of microscopes (*Olympus website*) | TBD |
| 2 (July 29) | Properties of Light  & Theory of image formation  *(Murphy chapter 2, p21-30 & Handouts*) | TBD |
| 3 (July 30) | Overview of Dyes & Fluorescence Microscopy  (*Murphy chapter 11, p199-230*) | TBD |
| 4 (July 31) | functions of filters, monochromators,  Cameras & Detectors  (*Murphy chapter 3, p35-50*)  (*Murphy chapter 17, p389-409*) | TBD |
| 5 (Aug 1) | Overview of image analysis and artefacts  (*Handouts*) | TBD |

**Activities/Lab Schedule (Afternoons)**

|  |  |  |
| --- | --- | --- |
| Day | Topics | Assignments |
| 1 (July 28) | Operation of basic microscope components  Collection of specimens and fixation | TBD |
| 2 (July 29) | Staining and mounting of collected specimens,  Observation of live and fixed specimens | TBD |
| 3 (July 30) | Observation of specimens using brightfield  microscopes | TBD |
| 4 (July 31) | Observation of specimens using  fluorescence microscope | TBD |
| 5 (Aug 1) | Image analysis and  Presentations | TBD |