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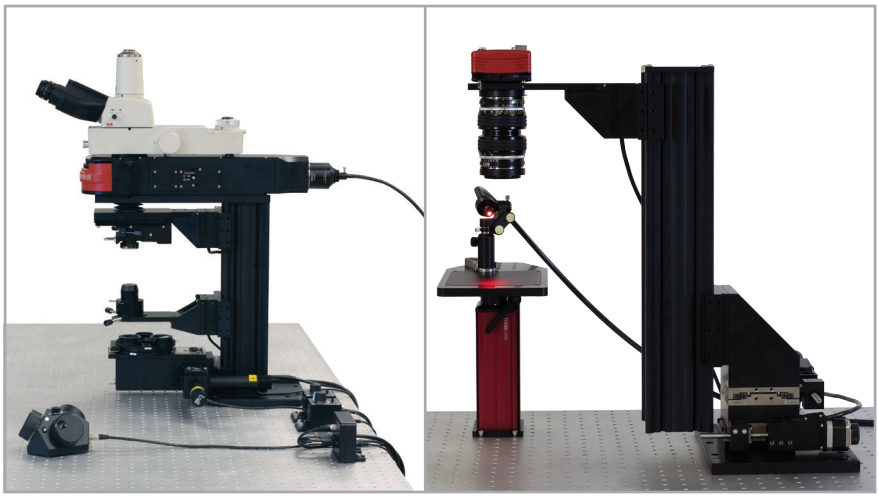
# Cerna® Modular Microscopes

Thorlabs' Cerna Modular Microscope Platform supports various conventional imaging modalities, including epi-fluorescence, DIC, Dodt gradient contrast, hyperspectral, and brightfield imaging, while utilizing a design that allows the system to be fully customized to address specific experimental needs.

## Microscope Bodies

The microscope body forms the core of a Cerna system. Each body includes a 95 mm dovetail rail that allows our DIY Cerna System Microscope Modules to be flexibly positioned along the entire body height.



Left: Epi-Illumination and DIC Microscope
Right: Functional Imaging Microscope

## Objective and Condenser Mounting

Each Cerna system can be outfitted with one of several dual- or single-objective nosepieces and a support arm for the condenser. The nosepiece or condenser module connects to the 95 mm dovetail on the Cerna body via a motorized stage with 1" of Z travel for focusing adjustment. In addition, we offer a piezo objective scanner for Z-stack acquisition with resolution down to 1 nm.

## Sample Holders

The large area under and around the objective leaves ample room for sample holders, perfusion equipment, micromanipulators, and other accessories to be mounted on the optical table. In addition, we offer a fast XY scanning stage that can be mounted directly to the Cerna body.

## DIY Customization

Cerna body attachments and extensions are designed to interface with Thorlabs' extensive line of lens tubes, cage construction systems, and other optomechanics, allowing truly custom setups to be integrated with any Cerna microscope.

CERNA®

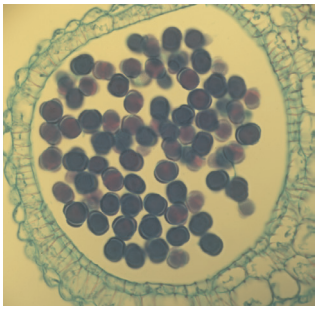
## Features

- Supports Conventional Widefield Imaging Techniques
  - Brightfield
  - Hyperspectral
  - DIC and Dodt Contrast
  - Epi-Fluorescence
- Slim Profile and 7.74" Throat Depth
- Adapters for Integrating Custom Modules Built from Standard Thorlabs Components
- Add-Ons for Confocal Imaging and Electrophysiology

Cerna Microscope with Custom Epi-Illuminator Module

Modular Microscopes & Components

## Widefield Viewing



Hyperspectral Image of a Brassica Flower Bud Cross Section

We offer both inverted- and erect-image trinoculars, along with microscope port and eyepiece adapters to secure custom cage and lens tube assemblies for image viewing and recording. Our scientific-grade cameras are available with resolutions up to 8 MP and imaging speeds of up to 200 full frames per second, with designs that cover UV to NIR wavelengths. The addition of a double camera port to the microscope enables simultaneous imaging with multiple modalities, such as epi-fluorescence and NIR Differential Interference Contrast (DIC) imaging.

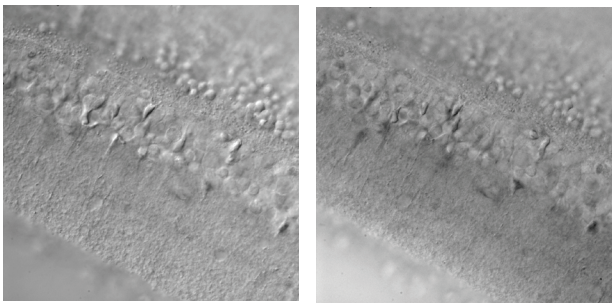
## Transmitted Illumination

Like the objective and condenser mounting arms, modules for brightfield, DIC, and Dodt contrast imaging can be attached directly to the Cerna body. All of our transmitted illumination modules accept input from any collimated source. Illumination kits provide an easy means of integrating up to two white-light, NIR, and/or colored LEDs into the setup, while the entrance and exit ports are 30 mm cage compatible to support the integration of optics or illumination sources from our wider catalog of components.

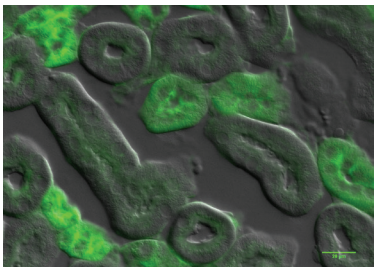
## DIC versus Dodt Contrast

To equip the Cerna® for DIC, we offer DIC objective and condenser prisms for objectives from 10X to 60X, a polarizer turret that mounts directly to the Cerna transmitted illumination module, and an analyzer compatible with our six-position epi-illuminator modules.

Dodt contrast is enabled by a modified transmitted illumination module that incorporates additional diffusers and one of five user-exchangeable quarter-annular apertures. This mask generates an illumination gradient that creates images at the camera comparable to those obtained using DIC.



Mouse Retina Imaged with DIC (Left) and Dodt Contrast (Right)



Combined GFP Epi-Fluorescence and DIC Image of a Mouse Kidney

## Epi-Illumination

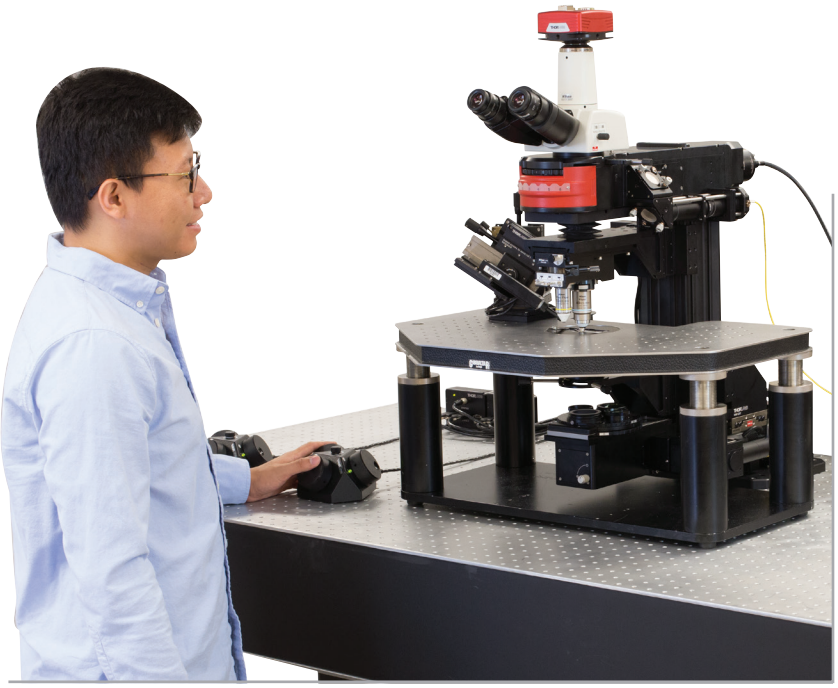
The Cerna microscope can be configured with a single-cube or six-position epi-illuminator module that accepts broadband white light sources or a variety of high-power LEDs. Alternatively, breadboard attachments, epi-illumination base modules, and dovetail adapters are offered to enable the construction of custom epi-illuminators from standard parts.

## Optical Accessories

In addition to the many modules that can be added and removed to quickly build a complete Cerna microscope, Thorlabs also offers microscopy accessories including filter sets, filter cubes, tunable bandpass filters, and air and oil immersion objectives.

## Interested in a Cerna System?

Whether you are seeking more information on our modular DIY Cerna Systems or a fully configured Cerna microscope, our dedicated team is here to provide assistance. Visit our website for more details on the many options available or contact us at ImagingSales@thorlabs.com.



Cerna Microscope System Equipped for Electrophysiology

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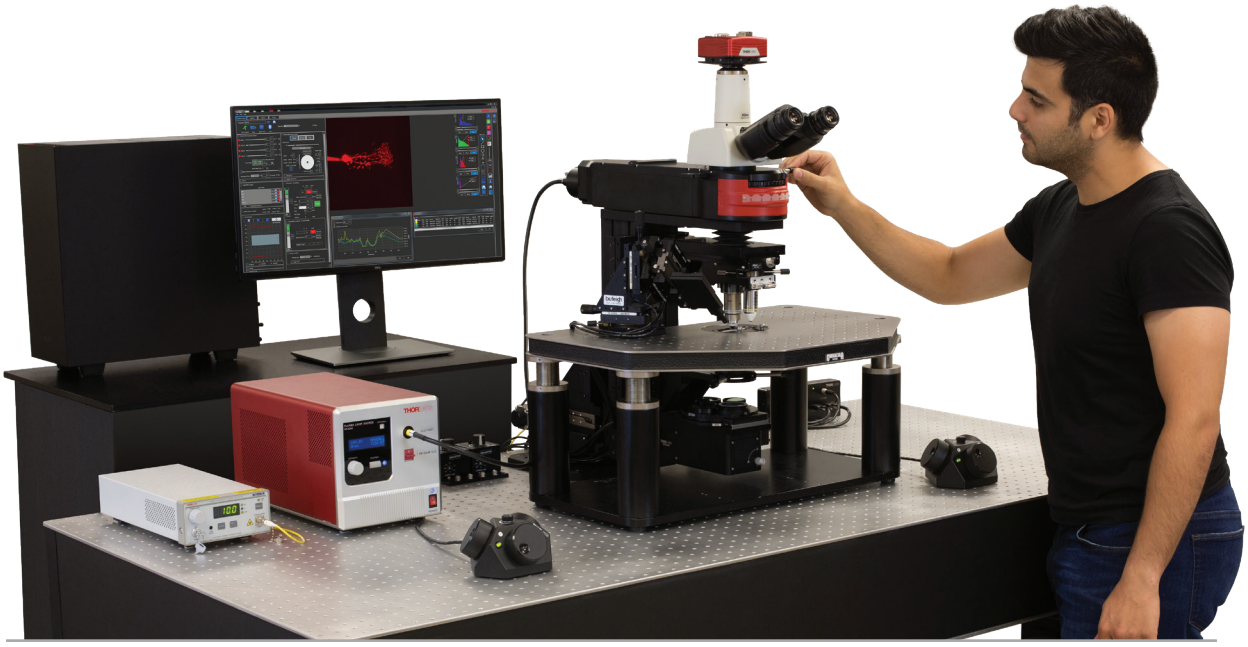
# Cerna® Microscope for Electrophysiology

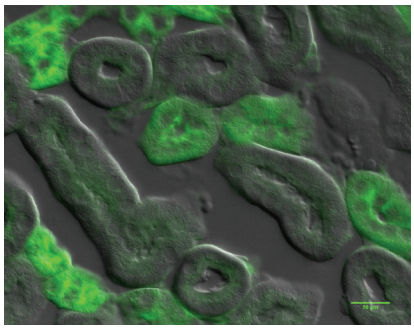
Epi-Fluorescence & DIC Imaging



This configuration utilizes a Burleigh® micromanipulator for precise pipette control during electrophysiology experiments.

## Features

- Compatible with Conventional Widefield Imaging Techniques
  - Brightfield in the Visible and NIR
  - Differential Interference Contrast (DIC)
  - Epi-Fluorescence
- Three Independent Illumination Paths with Light Sources Included
- Slim Profile and 7.74" Throat Depth
- Wide, Low-Vibration Gibraltar® Stage for Supplementary Equipment
- XY Microscope Body Translator
- Easy User Customization with Cerna® Components and Thorlabs Optomech



Combined GFP Epi-Fluorescence and DIC Image of a Mouse Kidney

Thorlabs' electrophysiology imaging microscope configuration is designed to be a workhorse for epi- and trans-illumination experiments. Its compatibility with a wide range of imaging modalities and modular design impart a high degree of experimental flexibility, making it ideally suited for a wide variety of needs, including whole-cell patch clamp experiments, thin and thick tissue sample manipulation, and histology.

This imaging configuration features three independent illumination paths – two for epi-illumination and one for trans-illumination – as well as a Gibraltar electrophysiology stage and 2" XY translator for the microscope body. The Cerna microscope body provides compatibility with a range of components and optomechanical assemblies, allowing the microscope to continually evolve with your experimental needs.

# Configuration Specifications

### General Microscope Features

- Microscope Body with 7.74" Throat Depth
- Upright Trinoculars and Camera Tube to Examine Sample During Image Acquisition
- 10X and 40X Plan Fluor Objectives
- Dual-Objective Nosepiece
- 0.78 NA Condenser Compatible with 4X to 100X Objectives

### Differential Interference Contrast (DIC) Imaging

- Transmitted Light Module with VIS & IR LED Illumination
- Polarizer Turret Suitable for VIS DIC, IR DIC, and Brightfield Imaging
- Polarizers for VIS & IR DIC Included
- Objective Sliders for 10X and 40X Plan Fluorite Objectives
- Condenser Prisms for N1 and N2 Objectives
- DIC Analyzer for VIS and NIR

### Epi-Fluorescence Imaging

- Epi-Illumination Module
  - Removable Turret for Six Filter Sets
- Primary Epi-Illumination Path: High-Power Plasma Light Source with Liquid Light Guide (LLG)
- Secondary Epi-Illumination Path: 488 nm Fiber-Coupled Laser Source for High-Contrast Fluorescence (e.g. Alexa Fluor™ 488, FITC)

### Electrophysiology Stage

- Gibraltar® Physiology Stage Provides Large-Area Work Surface for Experimental Apparatus
- 110 lbs Load Capacity
- Platform with Honeycomb Core for Vibration Stability

### Microscope Adjustment

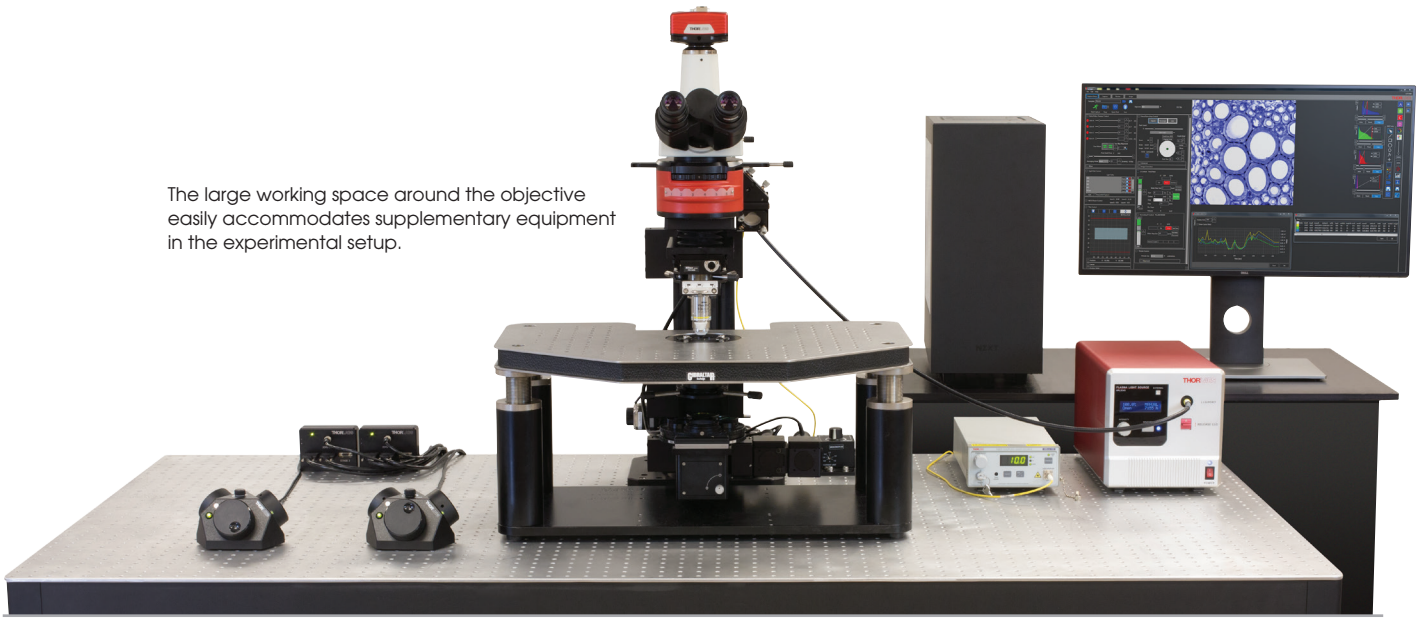
- Move Microscope up to 2" in XY without Disturbing the Sample
- Condenser and Nosepiece Utilize 1" of Motorized Fine Z Travel
- Positioning of Microscope, Condenser, and Nosepiece Adjusted with Two 3-Axis Controllers and Knob Boxes

### Image Acquisition

- Low-Noise 4 MP Scientific Camera
- Monochrome CCD with High Quantum Efficiency

### Computer

- High-Performance PC for Rapid Image Acquisition and Data Transfer
  - Two 6-Core Xeon Processors, 2.4 GHz Base Frequency (3.2 GHz Turbo)
  - 500 GB Solid State Drive
- Image Capture Using DAQ and ThorImage®LS Software



The large working space around the objective easily accommodates supplementary equipment in the experimental setup.

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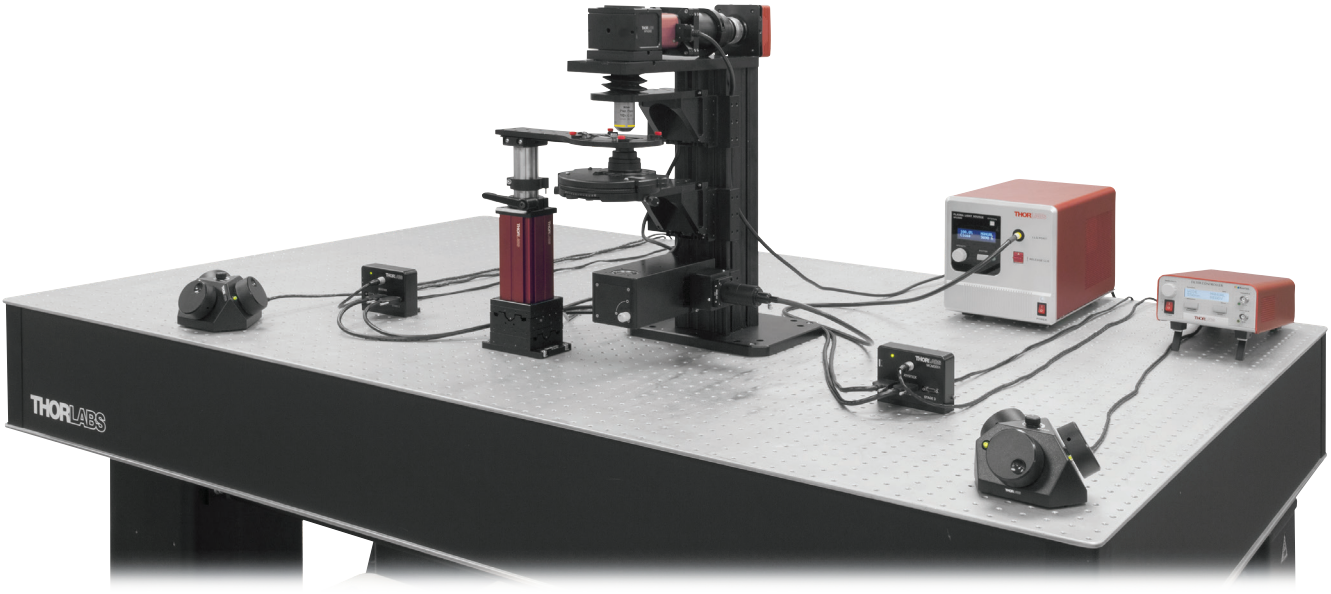
# Cerna® Microscope for Hyperspectral Imaging

Hyperspectral Imaging




## Features

- Image at Discrete Wavelengths to Detect Multiple Co-Located Features
- Kurios® Liquid Crystal Tunable Bandpass Filter for Vibrationless Wavelength Switching from 420 to 730 nm
- Low-Noise 4 Megapixel Monochrome Scientific CCD Camera
- Flexible and Customizable Cerna Microscope

Thorlabs' Hyperspectral Imaging Cerna Rig provides a platform for studies of samples with co-located features by spectrally separating the signals at different wavelengths. Traditional color cameras represent the entire spectral range of an image by using three relatively wide spectral channels—red, green, and blue. In contrast, our hyperspectral imaging system uses a tunable bandpass filter that allows narrow spectral regions to be imaged separately with a monochrome camera. The result is an image with quantitative spectral data for each pixel.

Our hyperspectral imaging system offers a number of advantages. Unlike approaches that rely upon angle-tunable filters or manual filter swapping, our Kurios filters use no moving parts, enabling vibrationless wavelength switching on millisecond timescales. Because the filter is not moved or exchanged during the measurement, the data is not subject to "pixel shift" image registration issues. Our system features fully automated wavelength switching and image capture using the included DAQ and ThorImage®LS software.

We have selected a standard set of components for a brightfield hyperspectral imaging system; the components and features are listed in the table on the reverse. Thorlabs' flexible Cerna platform allows the microscope to be easily upgraded to include additional features such as upright-image trinoculars, an epi-illumination module for fluorescence, visible and NIR DIC imaging, and Dodt gradient contrast imaging. In addition, systems for NIR hyperspectral imaging are available. For more information on all of the available options using our Cerna platform, please contact ImagingSales@thorlabs.com.

# Configuration Specifications

**General Microscope Features**

- Microscope Body with 7.74" Throat Depth
- 10X Plan Fluor Objective
- Nosepiece with 1" of Fine Z Travel
- 0.9 NA Condenser Suitable for Brightfield, Phase Contrast, Darkfield, and DIC
- Condenser Holder with 1" of Fine Z Travel
- Two 3-Axis Controllers and Knob Boxes

**Sample Holder**

- Adjustable-Height Slide Holder
- XY Translation Stage with 1" Motorized Travel

**Image Collection**

- Low-Noise 4 MP Scientific Camera
- Monochrome CCD with High Quantum Efficiency

**Illumination Source**

- High-Power Plasma Light Source

**Illumination Wavelength Tuning**

- Kurios® Liquid Crystal Tunable Bandpass Filter for Vibrationless Wavelength Switching
- Center Wavelength from 420 to 730 nm
- Select from Three Bandwidths
  - Narrow (10 nm FWHM at 550 nm)
  - Medium (21 nm FWHM at 550 nm)
  - Wide (55 nm FWHM at 550 nm)
- Switching Time < 200 ms

**Computer**

- High-Performance PC for Rapid Image Acquisition and Data Transfer
  - Two 6-Core Xeon Processors, 2.4 GHz Base Frequency (3.2 GHz Turbo)
  - 500 GB Solid State Drive
- Automated Wavelength Switching and Image Capture Using DAQ and ThorImageLS® Software

**Available Upgrades**

- Upright-Image Trinoculars
- Epi-Illumination Module for Widefield Fluorescence
- Visible and NIR DIC
- Dodt Gradient Contrast
- NIR Hyperspectral Imaging

## Application Idea

The data in these images demonstrate the hyperspectral imaging technique. Figure 1 depicts two images of a mature *capsella bursa-pastoris* embryo (also known as shepherd's purse) taken with the Kurios filter set to center wavelengths of 500 nm and 650 nm. These two images show that an entire field of view is acquired at each spectral channel. Figure 2 shows that a broadband spectrum is acquired at each pixel, permitting spectroscopic identification of different sample features within the field of view.

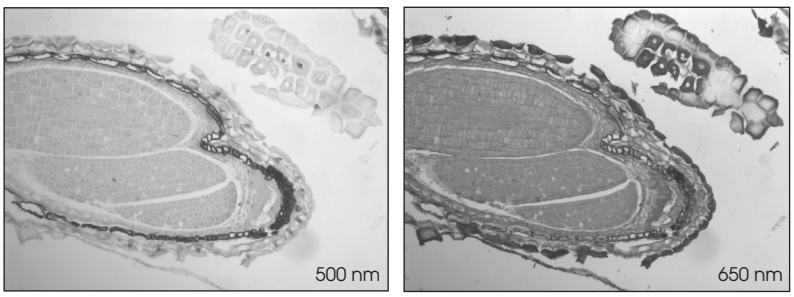



**Figure 1:** Two images of a mature *capsella bursa-pastoris* embryo taken at different center wavelengths. The entire field of view is acquired for each spectral channel.

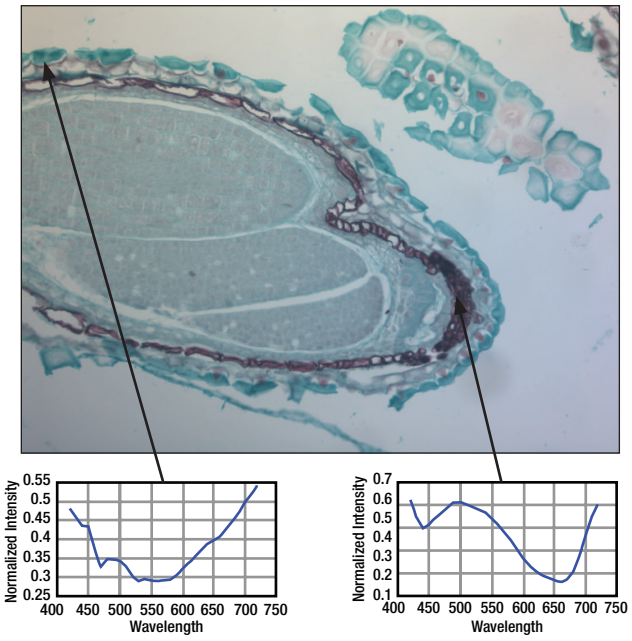



**Figure 2:** A color image of the mature *capsella bursa-pastoris* embryo, assembled using the entire field of view acquired in each spectral channel, as shown in Figure 1. By acquiring across multiple channels, a spectrum for each pixel in the image is obtained.