LumaScope™: an Inexpensive, Compact, Sturdy USB-Based Inverted Fluorescence Microscope.

Jennifer Kahle, Kenji Levin, Walter Niles, Brian Rasnow, Mel Schehlein, and Chris Shumate. Etaluma Inc., Carlsbad, CA

25.23

Introduction

- The LumaScope™ is an unconventional inverted fluorescence and brightfield microscope developed by Etaluma Inc. using recent technological advances and a philosophy of simplicity.
- For many demonstrations and experiments using fluorescence microscopy, only the basic features of a traditional inverted fluorescence microscope are needed.
- Full-featured fluorescence microscopes are expensive, complicated, and require relatively extensive training to use.
- We set out to develop a device that would be accessible, cheap, and easy-to-use, while providing laboratory-grade imaging capability.

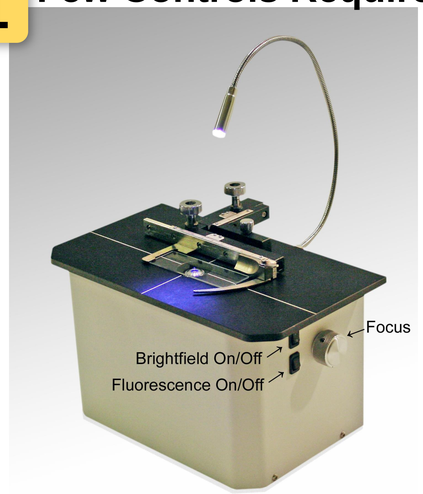
Methods

- We designed this device with a focus on: portability, small size, ease of use, continuous availability, and low price.
- We utilized recent advances in universal serial bus (USB) communications, light-emitting diode (LED) sources, and complimentary metal-oxide semi-conductor (CMOS) sensor technology.

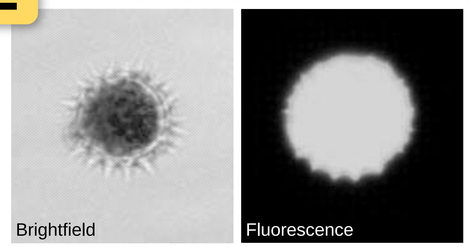
Results

- The LumaScope™ is a dramatically simplified fluorescence/brightfield microscope with the most useful capabilities.
- The compact size, minimal shrouding requirements, and robust construction of the LumaScope™ allow placement virtually anywhere: on each lab bench; within or next to environmentally controlled chambers, incubators, and hoods; on desks; in the field; and in teaching labs and classrooms.

1 Few Controls Required

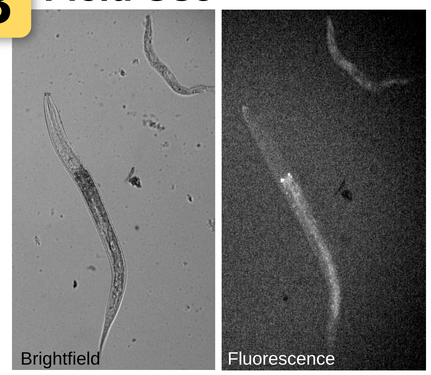


2 Intuitive for Students



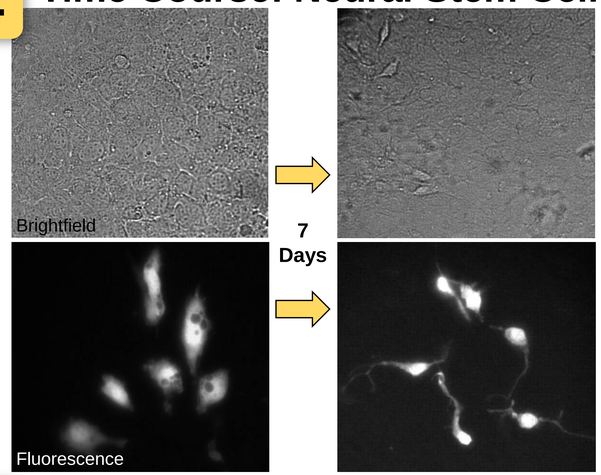
Several students (age 12-13) each unboxed, set up, and captured images with the LumaScope™ without adult coaching within about 15 minutes. Images of a pollen grain (Carolina) captured by a 12-year-old student during the first use, no coaching. 40x objective.

3 Field Use



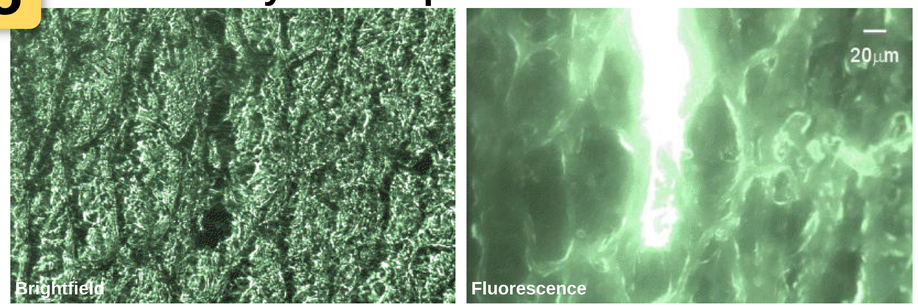
Images of living nematodes in a sample of standing rainwater. These worms exhibited auto-fluorescence. 40x objective.

4 Time Course: Neural Stem Cells



Mouse neural stem cells were followed over time as they developed in culture. In brightfield, the confluence of the cell monolayer is apparent. The fluorescence images show cells that are developing neuronal attributes. The expression of EGFP in these cells is under the control of a neurotrophin-3 promoter, which is only active when the stem cells start to differentiate into neurons. 40x objective

5 Wide Variety of Samples and Demonstrations

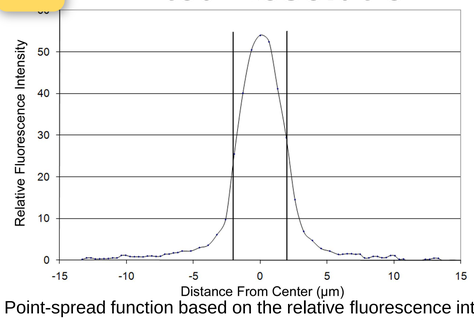


Rose petal labeled with fluorescein. The end of a rose petal was dipped in a drop of liquid from a standard highlighter pen. The liquid (fluorescein) was taken up into the petal via capillary action.

6 Fits into Small Spaces

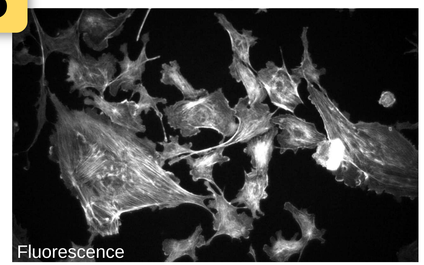
The LumaScope™ was designed to fit into small spaces, while still accommodating full-sized culture flasks or microplates. It has a low profile, and fits easily into a standard cell incubator.

7 Near Diffraction Limited Resolution



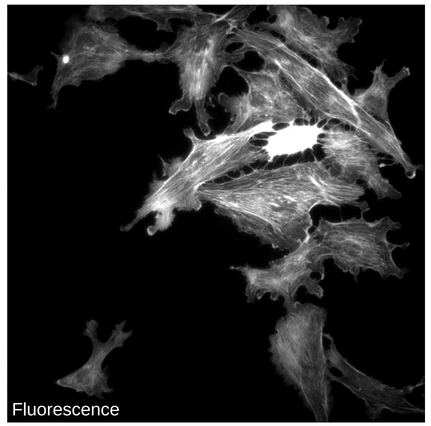
Point-spread function based on the relative fluorescence intensity of an image of a 4-μm calibration microsphere (FocalCheck™, Molecular Probes) corrected for background. The resulting full-width at half maximum (FWHM) is 4.388 μm. Vertical bars indicate the width of the microsphere.

8 Laboratory-Grade Images



LumaScope

Collected at 8 frames/sec using a 40x 0.65 NA Meiji objective (air).



Zeiss

Collected at 2 sec exposure using a 40x 1.2 NA Zeiss objective (water immersion). Zeiss Axiovert® 200M, Photometrics camera, arc lamp excitation. Courtesy of Dr. Paul Steinbach, Staff Scientist in the Dept of Chemistry & Biochemistry at UCSD.

Uncropped images of the same FluoCell® slide (Molecular Probes), both at 40x and set up for detection of AlexaFluor® 488. Contrast and intensity of both were optimized using standard methods and both were saved as grayscale jpeg images. Bovine pulmonary artery endothelial cells with phalloidin-labeled F-actin.

Conclusions

- The LumaScope™ is immediately accessible in several ways: rapid set-up, ease of use, and affordability. It is an order of magnitude less expensive than full-featured inverted fluorescence microscopes.
- The LumaScope™ is small, sturdy, and portable. It fits inside standard incubators, can be stacked and stored away in cabinets, and is easily carried.
- Images are comparable to those obtained with full-featured inverted fluorescence microscopes. The LumaScope™ yields bright images at fast image rates in fluorescence mode, enabling successful focusing and positioning of fluorescent samples.

Web Site

- This poster can be downloaded from: www.etaluma.com/products/lumascope

Presented at the Society for Neuroscience 40th Annual Meeting, November 13-17, 2010, San Diego, CA, USA.