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Scientiae Forum/My Favorite Site

Molecular Expressions: Exploring the World of Optics and Microscopy http://microscopy.fsu.edu

Kevin W. Eliceiri *

Laboratory for Optical and Computational Instrumentation University of Wisconsin-Madison 1675 Observatory Drive Madison, WI 53706, USA

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Abstract

Our knowledge of the structure, dynamics and physiology of a cell has increased significantly in the last ten years through the emergence of new optical imaging modalities such as optical sectioning microscopy, computer- enhanced video microscopy and laser-scanning microscopy. These techniques together with the use of genetically engineered fluorophores have helped scientists visualize the 3-dimensional dynamic processes of living cells. However as powerful as these imaging tools are, they can often be difficult to understand and fully utilize. Below I will discuss my favorite website: The Molecular Expressions Web Site that endeavors to present the power of microscopy to its visitors. The Molecular Expressions group does a remarkable job of not only clearly presenting the principles behind these techniques in a manner approachable by lay and scientific audiences alike but also provides representative data from each as well.

Keywords: Web Site; Internet; Optics; Microscopy; Imaging; Confocal; Multiphoton

There are several websites that attempt to explain advance light microscopy techniques but few do it as effectively as the Molecular Expressions group and none on the scale and breadth they have achieved. Funded as part of the National High Magnetic Field Laboratory at Florida State University (with additional funding from Olympus and Nikon) and led by Dr. Michael Davidson, the site explores the world of optical microscopy through extensive galleries of images and comprehensive tutorials on different optical microscopy techniques. The site has one of the Web's largest collections of "photo-micro-graphs"; color photographs taken through an optical microscope. The photo galleries feature thousands of images covering everything from cells (Fig. 1) and diatoms (Fig. 2) to ice cream and integrated circuits.

As strong as it is, as an image gallery website, it would be a mistake to classify it solely in this category. Rather than just present "pretty pictures" the site goes to great lengths to explain the biology behind the images. There are several detailed sections on cell biology covering everything from virus structure and plant cells (Fig. 3) to how drugs work.

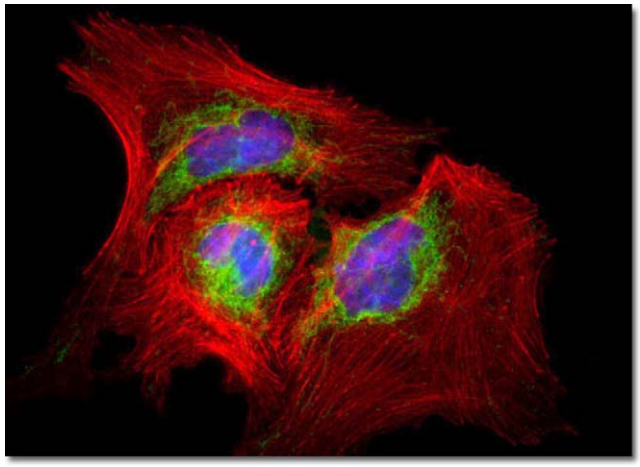

Fig. 1. Brightfield fluorescence image of multi-labeled HeLa cells in culture (from Molecular Expressions Website, reproduced with their consent).

The site does an impressive job of explaining important scientific principles such as cell division (http://microscopy.fsu.edu/cells/) not only with detailed pictures (Fig. 4) but animations as well.

The Molecular Expressions website is also a significant resource for explaining how the optical techniques work.

* Corresponding author.
E-mail address: eliceiri@wisc.edu (K.W. Eliceiri).

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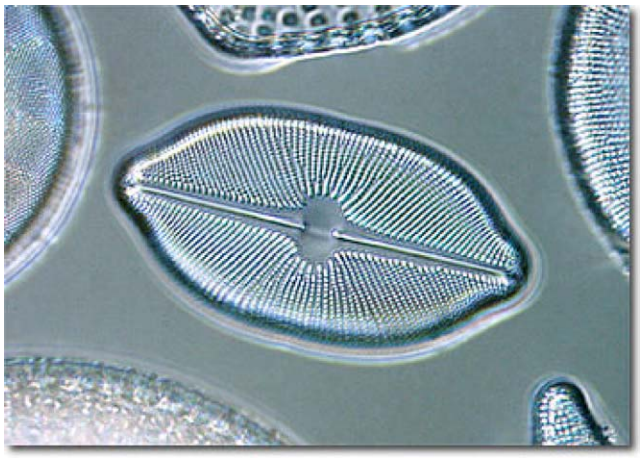

Fig. 2. DIC Image of intricate patterns on the diatom shell or frustules (from Molecular Expressions Website, reproduced with their consent).

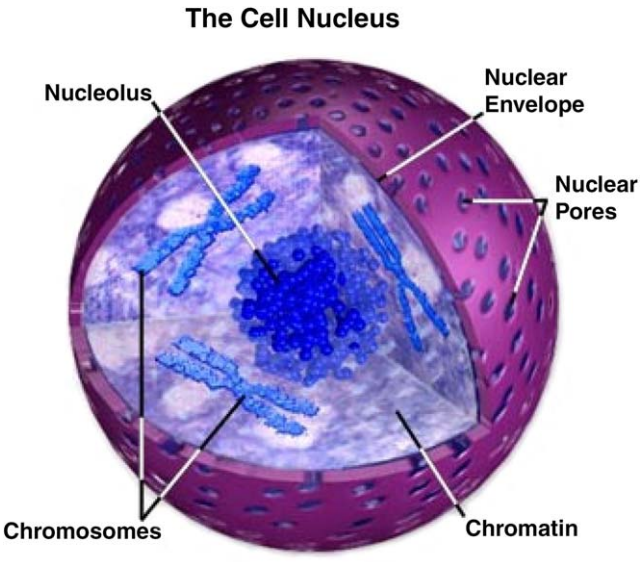

Fig. 3. Diagram of Plant Cell Nucleus (from Molecular Expressions Website, reproduced with their consent).

Through the use of system drawings and JAVA based animations the authors covering a wide array of microscopy techniques from phase microscopy and Nomarski to total internal reflectance microscopy and multiphoton microscopy. The history and components of the basic modern microscope are presented (Fig. 5) in a clear and concise manner. Students and researchers alike can explore the history and evolution of the modern microscope through galleries of early and modern microscopes and drawings that show how the optics and the light path have changed. In addition, more advanced imaging techniques such as confocal microscopy are explained. The benefits of these techniques are discussed, together with detailed drawings and animations of how they work (Fig. 6).

In addition to the more traditional mechanisms of content dissemination such as text descriptions, drawings and animations, the Discover Microscopy Website has put significant resources towards the creation of interactive JAVA tutorials

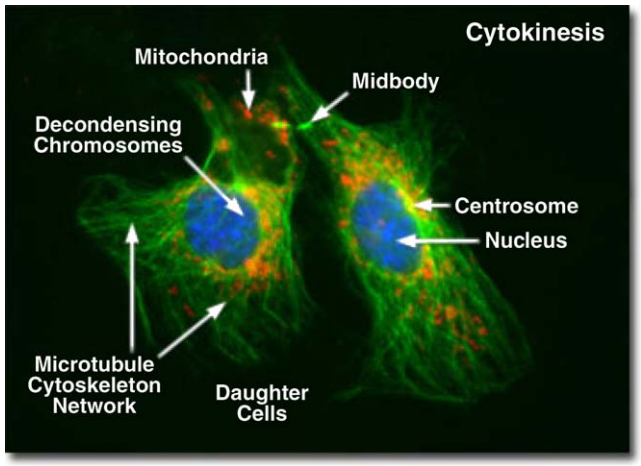

Fig. 4. Fluorescence Microscopy Micrograph from Molecular Expressions Series on Cell Division showing cytokinesis in rat Kangaroo kidney epithelial cells.
(from Molecular Expressions Website, reproduced with their consent).

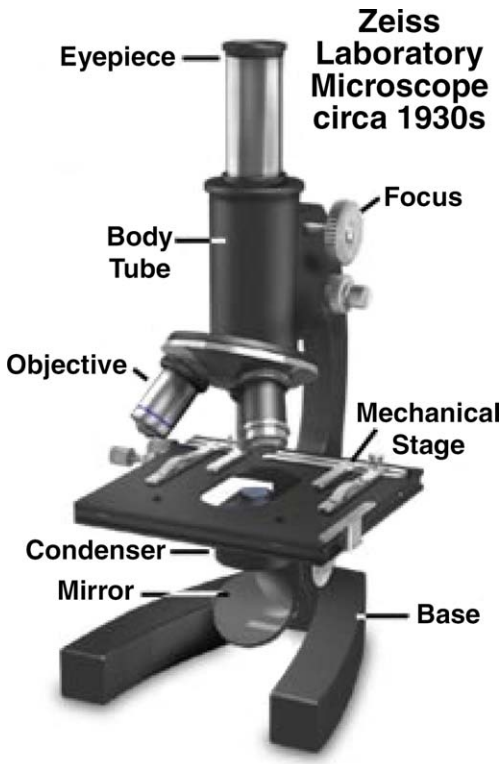

Fig. 5. Diagram of the basic components of a light microscope
(from Molecular Expressions Website, reproduced with their consent).

where visitors can directly explore everything from image enhancement and optical alignment to how CCD cameras and lasers work. This is all done in a very interactive way so that one can change filters, for example, on a light microscope and see the resulting image. Much of the site is geared towards informal science education, thus making it a great site for both professional microscopists and newcomers. However the site does have several dedicated areas specifically for students. One of the most significant of these is the "Science, Optics and You" section that presents an optics-

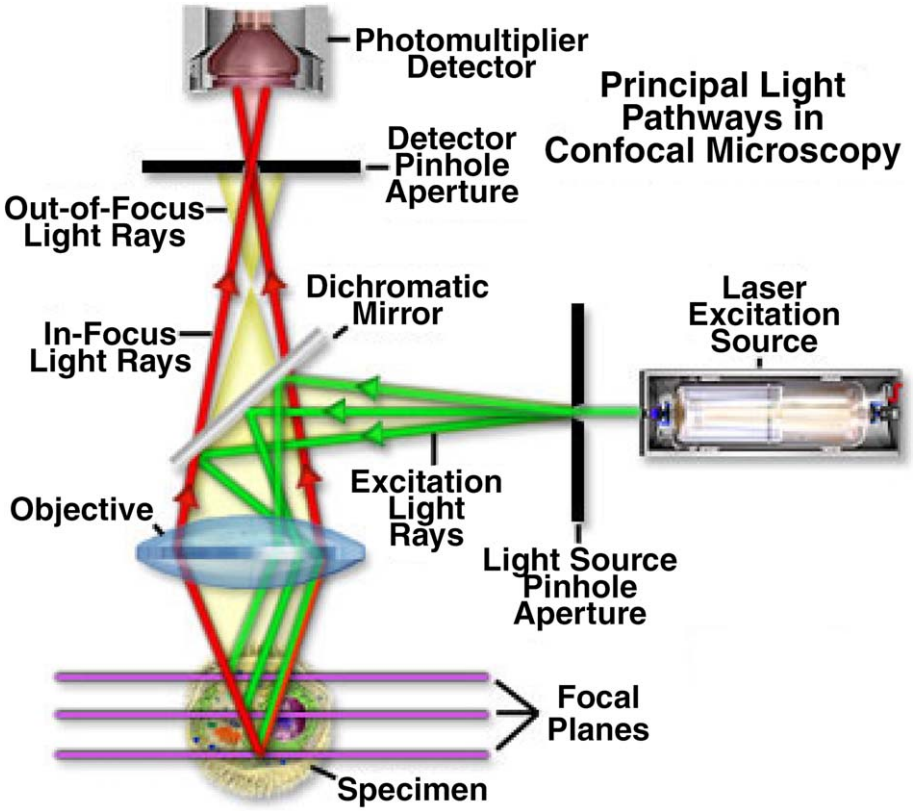

Fig. 6. Light Path of a Laser Scanning Confocal Microscope (from Molecular Expressions Website, reproduced with their consent).

based curriculum that teachers can implement in their classroom. This optics-based curriculum utilizes existing content from the main website and supplements it with detailed tutorials and practical exercises for the classroom. Popular entry-level classroom microscopes such as the Intel QX3 and Olympus MIC-D are presented with detailed animations of how they work and suggestions for applications.

Due to the breadth of the materials on the site (over 9,000 html pages and five million words with close to 1,000 pages of evolving content) it is difficult to summarize all the features and content of the Molecular Websites. This column has presented just a fraction of what is in there. I encourage the readers to visit the site themselves. The Molecular Expressions Website can be visited at the following URL http://microscopy.fsu.edu or one of the following sister sites: http://micro.magnet.fsu.edu, and http://www.microscopyu.com/ (over 3,000 pages of additional content).

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