

University of Michigan **Teaching Innovation** Prize

2009 WINNER



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Virtual Microscopy in Life Sciences Education

Innovation Description

The goal..

• create an interactive laboratory experience while removing impediments to learning such as malfunctioning microscopes, aging slide sets, and inconsistent tissue sections.

The solutions..

- produce high resolution digital replicas of optimal tissue sections.
- compile online image repositories.
- deploy intuitive, computer-based "viewers" that improve upon microscopes.

The user experience...

- web-based laboratory syllabi link directly to virtual slides and, in some cases, directly to annotated structures of interest buried deep in tissue sections.
- computer-based viewers provide effortless scan + zoom functions to the submicron level, permit side-by-side comparison of multiple tissue sections, link student generated annotations directly to regions of interest (or query), and provide 24/7 access to teaching materials.
- online tests incorporating virtual slides focus students' attention on the content of questions rather than the operation of the microscope.

The results.

- evaluations performed at the University of Michigan, University of Nevada (Reno), and the University of California (San Francisco) medical schools indicate that virtual microscopy creates an engaging, highly scalable, and effective laboratory experience.
- any scientific discipline that utilizes the light microscope can benefit from virtual microscopy.
- A team effort..

The project crossed departmental lines requiring integration of the slide scanning laboratory (Department of Pathology), the server infrastructure (Medical School Information Systems and Pathology Informatics), user support and training (Medical School Learning Resource Center, Cell and Developmental Biology and Pathology), and content developers (Cell and Developmental Biology and Pathology). The Virtual Microscope project achieved its aims through the collaborative efforts of many talented individuals from across the Medical School.

More information on project, personnel, and links to web sites at....

- http://www.pathology.med.umich.edu/Innovation2009_synopsis.pdf
- http://www.med.umich.edu/histology
- http://www.med.umich.edu/histology/dentalHistology.html
- http://www.med.umich.edu/digitallab/histopathology
- http://www.med.umich.edu/digitallab/M2schedule.html

Comments from Students and Faculty

"The Virtual Microscopy Project represents the most valuable innovation in the teaching of our discipline of Pathology (and normal Histology as well) that I've seen in over 5 decades of teaching.'

"VM lets students study how they want and when they want by giving them the ability to view slides during lecture, laboratory sessions, and from home. They can also concurrently view key text and graphic information, and save and label key images to review prior to exams."

"The real 'payoff' of the Virtual Microscopy Project is in its impact on teaching in our laboratories. ... Inherent in the virtual approach is the fact that precisely the same 'slide' is available to everyone in the class, and the instructor can ... manipulate it in real time to facilitate teaching. Another bonus of the Virtual Microscope is that with images displayed on laptop screens, pairs or small clusters of students can work together as teams, constantly interacting with one another and with their instructors.'

"Faculty can spend less time helping students individually locate cells of interest, and more time stimulating interactive discussions."

Greg Highison, Ph.D., of the University of Nevada School of Medicine wrote:

"Considering the overall educational merits of the Virtual Microscopy System created by the University of Michigan, three strengths stand out:

Scalability: The Virtual Microscopy Lab retains its versatility regardless of the student number. In our case we used the Virtual Microscopy lab in our freshman histology course of 62 students. Our labs are designed to be self-directed and interactive among students and between students and faculty. And we have also used the virtual slides in small groups and individual reviews.

Portability: We have used the Virtual Microscopy slides in lecture halls, small group rooms, various individual on-campus sites, as well as off-campus sites. It can be used anywhere there is internet access.

Versatility: Virtual Microscopy slides are capable of being easily incorporated into other disciplines. We are planning to use the virtual slides to preview pathology labs in the second year. The Systems Physiology course is planning to use portions of the Virtual Slides to introduce renal and respiratory sections of the curriculum. As the Virtual Microscopy Lab continues to evolve, new and innovative uses will be found.

There is no question, access to the Virtual Microscope Lab revitalized the Histology Program and Faculty at the University of Nevada School of Medicine. Sincere thanks to [you] on behalf of the University of Nevada School of Medicine."

Examples of Teaching Innovation

- The Medical Histology Digital Syllabus (http://www.med.umich.edu/histology) • Online laboratory manual consists of Webpages with descriptive text and direct links to virtual microscope slides.
- Virtual slides can be opened from Webserver in Aperio ImageScope viewer (available at http://www.aperio.com/download.asp) or delivered as a flash object in a "WebViewer" window (for Mac users or those without ImageScope installed).
- "Example" links open virtual slides at a region of interest to focus on a particular tissue or cell type.



Example views above are from http://www.med.umich.edu/histology/sample.html

M2 Pathology Digital Syllabus (http://www.med.umich.edu/digitallab/M2schedule.html) • Online laboratory manual consists of Webpages in a format similar to the Histology site. • Lab exercises are generally more case-based, featuring histories, physical and laboratory findings, and

- open-ended questions to encourage discussion among students and faculty.

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Example views above are from http://www.med.umich.edu/histology/HemeLabSample.html

Virtual Microscopy in the Classroom (and Beyond)



can be easily "shared" in the classroom setting either via an LCD projector to an entire group or on ndividual computer screens in the lab sessions. The format lends itself to pair-based learning, and it is easy for an instructor to answer questions or point out features of interest



Access to the virtual slides is not limted to the labs. Students may review the lab material on their own in computing centers anywhere on campus or wherever they have access to the Internet.



Aperio ImageScope v10.0.35.1798 - [029-1_HISTO_40X.svs]

Using the annotation feature in ImageScope, students can label cells of interest or note items about which they may have questions if an instructor is not immediately available. Annotations created in ImageScope do not alter the digital slide. Instead, they are stored as local files on each student's computer and overlaid on top of the slide when opened.