Frugal Microscopy: Inspiring tomorrow's interdisciplinary scientist

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Over the last 400 years, microscopy has transformed from a 17th Century pastime hobby to a striving industry that is forecast to be worth more than US$ 3.98 billion dollars by 2017. The much revered strength of microscopy is the keen ability to reveal hidden microscopic processes that elude the naked eye. The usage of 21st Century materials and digital imaging technology has rapidly changed how microscopy is performed. While the pursuit of a low cost, but high power mobile microscope of small form factor could be pivotal in a myriad of practices in medicine, agriculture, geology, ecology and marine biology, it is more needed in the classroom. With the latest innovation in mobile microscopy, it is not difficult to envision its impact in education - inspiring the next generation of interdisciplinary scientists.

2015 Year of Light

2015 marks the International Year of Light. While we celebrate the triumph of optical technology embedded in a multitude of disciplines in sciences, engineering and medicine, this is also a time to reflect and revamp our education of optics and photonics in the classroom. It is arguable that Antonie van Leeuwenhoek, an unremarkable tradesman, made a cornerstone in science by demonstrating how a homemade high powered lens can readily revealed a whole new world beyond our naive vision. As the result of his discovery, he conveniently gave birth to the field of microbiology (Brian 1981). An important link that Leeuwenhoek's 17th Century hobby has forged is the one between optics and biology. Optical scientists continue to invoke fascinating technical wizardry as tools for biologist to analysis the microscopic.

Microscopy, the ability to see the very small, is a simple but powerful technique to illustrate to students of all ages the marvels and power of optics. The appeal of microscopy, much like astronomy, is that it stimulates students to look beyond just focusing light through a simple lens. Students can candidly view a hidden world that goes beyond their own. However, modern optical microscopes have move beyond Leeuwenheok's single glass lens, and cannot be easily replicated in classrooms. Hence, microscopy remains out of reach for many.

Frugal Microscopy?

Whitesides (Whitesides 2011) spoke of a new field of "frugal science", where innovation of cost effective technology is important for healthcare and business in the developing countries. In many ways, frugality applies in education as well. Until now, classroom optics lessons generally concentrate on optical illusions, pinhole cameras and simple lenses. These kits may educate simple optical principles to students and costs very little, but they do not adequately demonstrate the interdisciplinary impact of optics. To many educators, it is difficult to imagine how traditional microscopes that are bulky and costly can be brought to the classroom. Since modern microscopes do not integrate well with mobile technology, a conscious effort needs to be made to add frugality as a criterion for innovating optics education: optics at almost zero cost.

How can we achieve this? The best thing is this trend is already set in motion.

Affordable Mobile Microscopy for Classrooms

The emerging trends in mobile microscopes is to take advantage of inexpensive CMOS sensors (Hayden 2009), smartphones (Coskun and Ozcan 2014, Lee, Upadhya et al. 2014), inexpensive materials (J Cybulski 2014, Lee, Upadhya et al. 2014) and computing technology (Zheng, Horstmeyer et al. 2013, Ozcan 2014) and even the use of direct computational techniques with just sunlight (Lee and Yang 2014). It is quite possible to take these existing cutting-edge low cost microscopy research techniques and tailor them to the classroom setting. This small step could have a significant influence on the next generation of optical scientists everywhere. Many of whom will move onto building higher power microscopes and solving the biological problems of their time.

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