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The CellScope: Not Just for James Bond Any More

Fitted with the right optical magnification equipment, a cell phone can be a powerful tool for science education.

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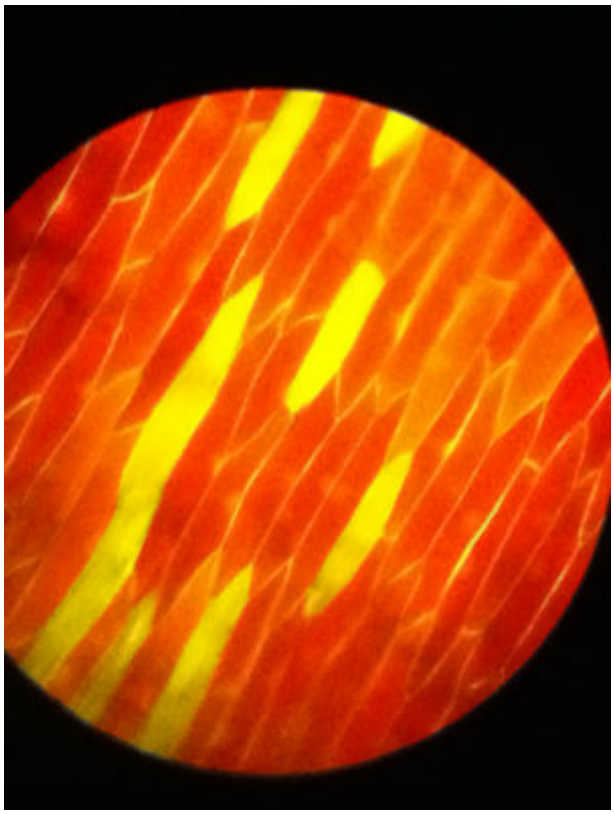

The Gist

Want to see a teacher cringe? Utter the words “cell phone.” However, new research by bio-engineers at the University of California, Berkeley suggests that teachers need not fear the phones. In fact, cell phones can help students learn about science.

In a recent project, Berkeley researchers introduced cell phones outfitted with magnifying optical equipment (“CellScopes”) into a middle school science classroom at the San Francisco Friends School. The devices were an instant hit. According to the scientists’ findings, presented today at the American Society for Cell Biology's Annual Meeting, the CellScopes engaged students’ interest in the study of microscopy, and also opened up new possibilities for interactive learning.

The funny thing is, CellScopes were never designed for the classroom.

The Expert Take

Professor Dan Fletcher, the father of the CellScope, first envisioned the device as a tool to aid in disease diagnostics in the developing world. He hoped that the CellScope could be used to take an image of a patient sample in the field, and then to send that image to an off-site doctor for analysis.

Fletcher began the project in 2006, with an exam question. He asked his students how to turn a cell phone into a microscope. The following spring, using standard microscopy optics parts (e.g. an eyepiece, tube, lenses, and light source) Fletcher and his students built a prototype. Since then, the CellScope has been refined, and the device has been deployed in Vietnam, Ethiopia, India, and Thailand to help diagnose tuberculosis, eye problems, and other maladies.

No one thought about using CellScopes in the classroom, however, until a serendipitous chance meeting in 2010. That summer, Dr. Eva Schmid and Dr. Oliver Hoeller, two postdoctoral students working with the CellScope, met Saber Khan, a middle school science teacher at the San Francisco Friends School. Saber convinced the students to teach a few biology lessons to his class. Schmid and Hoeller planned to teach a lesson on cell motility or coral symbiosis with photosynthetic algae.

Schmid explains that, “since most of our research benefits greatly from the use of microscopes…Oliver and I brought CellScopes from the lab into the classroom. The students loved the devices and were excited about the possibility of doing hands-on experiments.”

Sensing the students’ enthusiasm, the researchers lent the class five CellScopes to use during the school year. Using the devices, the middle schoolers completed a “Micro:Macro” project. In this activity,

the students took macroscopic and microscopic pictures of common objects around their homes—plants, food, dog hair, etc.

In completing the project, the students interacted with the microscopes in a meaningful way. Schmid explains that the students “had to learn more about samples when they prepared them at home than [they would have] if they were handed prepared slides.”

And the CellScopes had an added bonus. Remember waiting your turn to look into the microscope? Schmid says that, with the CellScope’s touch screen, “more than one person could see the object at the same time, so they [could] discuss” what they saw. In fact, the students could even take notes right on the screen.

As Schmid explains, “it is much more exciting for a kid to use something attached to an iPhone than to [use] an old and dusty microscope.”

Despite all the excitement, it's important remember that the CellScope is not a finished product. As Schmid explains, the researchers are still “working on cost reduction, as well as the sturdiness” of the device. Moreover, the researchers have not yet conducted a quantitative study to measure the success of CellScopes in the classroom.

Nonetheless, Schmid and her team are excited. They hope to expand the program to give more students a chance to work with the devices.

"We would love to see a traveling loaner kit that enables public schools to get access to a set of 20 devices and [a] curriculum to teach and excite kids about microscopy and science,” Schmid said.

The researchers also have several collaborative educational outreach projects planned or underway, in conjunction with institutions like the California Academy of Sciences, the University of Hawaii, Deutsches Museum in Munich, and Biolution in Austria.

Source and Method

Schmid and Hoeller evaluated the use of CellScopes in middle school science classrooms. They introduced five CellScopes into a class of 15 seventh and eighth graders at the San Francisco Friends School, under the guidance of teacher Saber Khan, during the 2010-2011 school year.

The students carried out a “Micro:Macro" project, during which they used the CellScopes to take macroscopic and microscopic photos of objects.

Moving forward, the researchers hope to gather quantitative data on the educational programs and to publish their findings.

The Takeaway

While the CellScope outreach program is still young, early results suggest that CellScopes show great promise in education. Given this success, educators and parents can take heart, knowing that, as Schmid puts it, “the use of modern technology is a powerful tool in classrooms”—not just a distraction.

In fact, CellScopes could engage students in learning about science in a way that traditional technology has not. The CellScopes harness something that the students already love—technology—and use that passion to ignite a love of learning. This could be especially important in an age when many worry about American students' declining scores in math and science.

Other Research

In 2009, the Berkeley researchers who built the CellScope published a paper on the device in *PLOS One.*They demonstrated the device's potential for clinical use by imaging cells infected with malaria and tuberculosis. In all cases, the image resolution was high enough to identify morphology, or cell shape.

In a study published in *Lab on a Chip*, researchers used a holographic microscope installed on a cell phone to create images of various microparticles. They tested the device on red blood cells, white blood cells, platelets, and *Giardia*, a waterborne parasite.

In a 2011 study, researchers at the University of California, Davis and California State University, Sacramento, developed attachments for a cell phone that turned the phone into a 350x microscope. (By comparison, CellScope magnification ranges from 8x to 120x.) The researchers then imaged stained and unstained blood smears. The researchers found that, using the phone, they acquired images similar in quality to commercial microscope platforms.