

# OpenLabWare

## A new paradigm for research education

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OpenLabWare (OLW) was born in April of my freshman year, in between Buildings 16 and 56, in a flash that covalently bound three ideas:

- first, that teaching the axioms of discovery and innovation through research education is the most valuable gift we can grant our students;
- second, that “what researchers do” should be as intuitive and well-known as “what doctors do,” and
- third, that this can be done on a large scale via the Internet.

I see OLW as the ultimate teaching tool. Imagine this scenario: you are a biology teacher in a small rural town. Your budget is almost as restrictive as the curriculum you were prescribed, and you have to make sure that your students receive high grades on their standardized tests, or you will be held responsible. Life would be so much easier if the students actually wanted to learn the chalk-dry material, but you just don't have the time to prepare a cool demo and you're too far away from any lab to plan a field trip. What would you do?

Research universities such as MIT are uniquely positioned to alleviate this problem; we have already taken the first steps by publishing our course materials on-line to the web via OpenCourseWare. But, rigorous as it is, MIT's academic program is not our primary focus. Our bread and butter is research. We already do a wonderful job of publicizing and teaching the results of our research (the MIT homepage is just one of many examples). However, we don't teach the process by which we arrived at our results, and we rarely provide an in-depth look at the human beings behind the discoveries.

OpenLabWare can fill this void. Each OLW module (think of it as the structural analog of a course on OCW) dissects a scientific paper published at MIT, documenting the story from problem to publication. The module is introduced with an overview to provide the necessary scientific background as well as context for the work. The reader can then browse through a timeline containing annotated scans of the first author's lab notebook. More difficult experiments are linked to video interviews with the authors explaining their experimental design and data analysis. The published article is available in HTML or PDF formats. From the article, a glossary containing difficult or obscure words is created, and moving your mouse over one of these words in the paper generates a pop-up window containing its definition. Finally, Facebook-like profiles of all the authors list generic scientific information (research interests) as well as personal information, in both text and video formats. You might learn, for example, that Prof. John Essigmann is an expert safe-cracker, or that Prof. Barbara Imperiali is an avid SCUBA diver...

So, if you were the biology teacher, what would you do? Imagine if you could use MIT research as a case study. You might put forth a hypothesis and then ask the class to design an experiment that would test that hypothesis. Then, once the experiment

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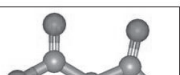
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#### Module Home

**Structural identification of the major DNA adduct formed by aflatoxin B<sub>1</sub> in vitro**

J. M. Essigmann  
R. G. Crox  
A. M. Nadzan  
W. F. Busby, Jr.  
V. N. Reinhold  
G. Buchi  
G. N. Wogan

**Research question:** What is the structure of the compound formed when aflatoxin B<sub>1</sub> reacts with DNA?



has been agreed upon, you explain what was actually done and why. The results are displayed and you ask the class to interpret them. Then you ask what experiment they would perform next and why, and this too is compared to what was actually done. OLV would greatly decrease the activation energy in planning a class like the one above; it would allow free and easy access to all the necessary materials.

The example above is what I mean by “research education:” science education that emphasizes the process rather than the results. We have a unique opportunity to model the creative individuals who make tomorrow’s discoveries, reveal their train of thought, and explain how their research affects all of our lives. We must take advantage of it.

Because OpenLabWare is focused on labs instead of courses, we can finally begin to explain to students that ‘physics-chemistry-biology’ is not all there is to science, and we can communicate early on what engineering is all about. In future modules, we plan to incorporate elements of the peer-review process, so that students can practice evaluating scientific arguments.

OpenLabWare is good for business on the MIT side as well. Modules are written and compiled mostly by undergraduates, giving them an opportunity to become very familiar with professors and their research. Professors get publicity for their lab, and the process of making a module takes (on average) no longer than preparing a course for OCW. When more modules appear on OLV, there will be opportunities to link between modules and especially from modules to MIT classes on OCW, which will provide both MIT and non-MIT instructors with an easy way to link their class material to cutting edge research.

OpenLabWare would not be where it is today without the hard work of a truly talented team. First on board was my academic advisor, Prof. John Essigmann. John gave me the encouragement that I needed to get going, and believed in the project so strongly that he served as the guinea pig for the prototype module. John’s wife and co-Housemaster at Simmons, Ellen Essigmann, gave us the idea to apply for an Alumni Sponsored Grant. I am incredibly indebted to Prof. Doug Lauffenburger, who not only helped us secure the \$25,000 grant, but funded a trip to Thailand to explore the global dimension of OLV and determine how to adapt the website for effective use in other countries. During the trip to Thailand, Professors Ram Sasisekharan and Bevin Engelward helped me structure and focus the OLV vision. Anthony Rizos ’09 and Chris Varenhorst ’09 are the wizards behind the website. They engineered a structure that allows modules to be “plugged in” with minimal effort (or knowledge of PHP/MySQL!). Last but certainly not least, nine students are currently producing five exciting new modules, two of which will be online by the beginning of summer.

OpenLabWare started as an idea, and if it were not for the incredibly entrepreneurial MIT atmosphere, it would still be just that. MIT truly is a meritocracy—if you have a good idea, you have the power to make it happen.

To find out more about OpenLabWare, visit the site at <http://olw.mit.edu/>. Want to join the team? Have questions or comments? E-mail [gsz@mit.edu](mailto:gsz@mit.edu).

