Enabling technology for new approaches to learning

The Virtual Laboratory provides a flexible and powerful workspace in which students can design and carry out chemical procedures and experiments on samples collected or created in other environments. It can therefore support a variety of new types of learning activities. For instance, we are using these tools to place core chemical concepts in interesting medical, environmental, and technological contexts. Our authoring tools allow instructors and others without programming expertise to create highly interactive student activities that utilize the Virtual Lab.

Instructor Authoring Tool

An initial release of the Virtual Lab’s authoring tool is available on CD and our website. Instructors now have a graphical means of configuring the Virtual Lab to suit their curriculum. The tool gives instructors control over the various aspects of the lab, making it easy to create all types of homework problems.

Invitation to Instructors

The Virtual Laboratory is being used in a diverse range of university settings. We are seeking college and high-school faculty to test the Virtual Lab software with their students during this academic year. Please contact us if you would like to use the software in your class. Pre-written curriculum and software are provided free at: http://www.chemcollective.org/

Contact Information
Email us at info@chemcollective.org or call (412)268-7914
The philosophy underlying our work stems from two challenges in science education: (i) Students are too rarely engaged by their science courses and (ii) many valuable shifts in pedagogy are difficult to undertake in large introductory classes. Our goal is to make introductory chemistry more exciting and conceptually rich through online interactive assignments that integrate smoothly into existing courses by enhancing current homework and prelab activities.

**Comprehensive coverage of aqueous chemistry:** The Virtual Laboratory allows students to select from hundreds of standard reagents and manipulate them in a manner that resembles that of a real lab. It allows students to design and perform diverse experiments in acid-base chemistry, thermochromism, solubility, and redox chemistry.

**Easy to use:** Transferring solutions in the Virtual Lab is as easy as drag and drop. User studies on high school and college students indicate that the user interface takes about 5 minutes to learn.

The Virtual Lab allows current paper-and-pencil homework to be supplemented with online activities that provide varied practice. Activities range from using the lab to check answers to conventional paper-and-pencil exercises, to designing experiments in pursuit of realistic goals.

**Multiple representations to aid conceptual understanding:** The lab bridges textbook equations and laboratory activities by showing multiple representations of solution contents, including aspects that would not be visible in the physical lab. Comparison with paper-and-pencil calculations provides realistic feedback. When their answers are not correct, the intermediate results provided by the learning environment give the students a means to explore why.

**Easy integration into existing courses:** Our authoring tool allows instructors and others without programming expertise to create highly interactive student activities that utilize the Virtual Lab. Popular problem types include:

- **Calculation checking**, where students carry out the procedure described in a textbook problem and verify their answers with the simulation.
- **Online experiments**, where students determine how to carry out common laboratory procedures to answer chemical questions.
- **Design problems**, where students use chemical concepts in pursuit of meaningful goals.
- **Crosscutting, contextualized problems** that require students to use knowledge from various parts of an introductory course as well as potentially provide exposure to concepts from other disciplines such as biology and physics.
- **Prelab activities** that better prepare students for the physical lab, and postlab activities that promote deeper understanding of the concepts covered in the lab.