Using the web to access real-world data

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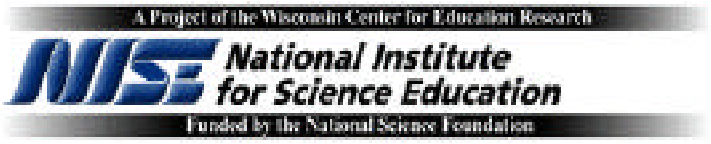

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This quicklook also is available from the
Learning Through Technology web site,
http://www.wcer.wisc.edu/nise/ilt/

Using the web to access real-world data

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Why technology?

The web provides access to data and information that my students and I couldn't otherwise easily obtain (or if we could, it would take too long to get our hands on it!). I teach an introductory level chemistry course that is structured around investigations of current issues in chemistry such as air quality, the ozone layer, global warming, and energy conservation. To teach these topics effectively, I need up-to-date, real-world data and I need current information on these topics – usually fast! The web has a wealth of

- **scientific data**. Sites like the EPA, the NASA, the NRC (Nuclear Regulatory Commission) provide air quality data by city, ozone levels over cities, stratospheric ozone data using the NASA satellite, and the pH of lake water in Minnesota in real time data.
- **current information on quickly-changing issues**. I can find information on who has signed the Kyoto protocol, who were the biggest carbon dioxide emitters over the past year, who has been trading emission credits, and what the ozone hole was doing this fall.

The strategy

The web fits very well when chemistry is taught in a real-world context with an issues-based format. And, it helps my students to acquire skills that I think will be important for them personally, as voters, and as global citizens:

- Locate information on the web related to local, national, and global scientific issues that affect them;
- Explain in writing what they have found;
- Argue, using scientific data, for or against a particular issue; and,
- Take a stand on an issue using scientific data as evidence.

In addition to developing these "scientific literacy" skills, the students learn chemistry along the way – but on a “need to know” basis. Chemistry is embedded throughout these topics and an understanding of the related chemistry concepts is essential to arguing one's point. About a third of the exercises are controversy-based and require students to argue a point using chemistry. For example, these exercises ask:

- When does it make sense to drink bottled water?
- Should we support and ratify the Kyoto treaty?
- Is it OK to eat foods containing olestra?
- Are tanning beds harmful?
- How can we as a nation deal with nuclear waste?

An example exercise on bottled water is:

> "Select two websites that deal with bottled water: one by a supplier and the other a consumer information site. The former may flood you with statistics about the benefits of bottled water, the latter may raise questions such as, Is bottled water safer or is it worth the cost? For each site list the title, author, URL and two things from the site that you learned about water. Get the two opposing viewpoints and let's start talking."

This exercise motivates a discussion on water as a chemical. What is water? How pure is it? What do you expect to find in it? How does it behave? What are the issues of drinking water on this planet? So, this covers (to name a few topics): solvents, concentrations, molecular structures and the physical properties of water and hydrogen bonding.

Many of these topics came directly out of a book that I co-authored, ***Chemistry in Context: Applying Chemistry to Society,*** a project of the American Chemical Society. There are also web-based real world exercises that go along with the book.

This contextual approach to chemistry sometimes is criticized as "watered-down" chemistry. But anybody who teaches a course like this quickly learns how complex and quickly changing real-world chemistry topics actually are. Although we don't teach using a "standard" chemistry curriculum (first atoms and molecules, then moles, bonding, gas laws, etc), we still cover most of the same topics – the order is just very different because we cover topics on a need-to-know basis to understand the issue at hand. In fact, the concepts we cover are actually ***more*** difficult because of the real-world emphasis: the chemistry of air, water, the environment, and the stratospheric ozone is extremely complex.

Teaching chemistry in this way definitely requires more work on my part. I first had to learn the chemistry of topics like nuclear waste and photochemical smog because these certainly weren't covered in my own Ph.D. training. And, each semester I have to research the new developments. For example, once I have put together information about stratospheric ozone, I can't just sit there and teach it the same way year after year.

The learning technology

The web is one primary learning technology that I use. All of the homework assignments are on my course web page and many involve searching the web for data and/or information. My website also has the syllabus and a calendar that organizes lecture notes, PowerPoint presentations of the lectures, practice exams, homework assignments, due dates, weekly quizzes, and exams. Students hand in their homework via email; they email it to their TA and copy it to me. The page I think students use most is the calendar that outlines due dates for assignments, exam times, and when assignments are handed out.

I keep my site fairly low-tech because I want it to be simple to modify and because I really haven't needed to make it hi-tech. My goal with the website is to point students to real-world sites: they don't need to spend a lot of time on my own site.

Course

I use the web in my general chemistry course (called Chemistry 108) for liberal arts students who are not pursuing a science major. It has 250 students in the fall, and 120 in the spring (when it is a writing intensive course that satisfies the University's general education writing requirement). I have the help 5 or 6 TAs for the course, almost all of whom request to teach with me in the course.

Project support

In 1996, I was the first person in my department to use the web in teaching general chemistry. I learned how to create a web page from a campus technology support center called Learning Support Services. The class met three times in one week (2 hours each) and by the end of it we all were proficient in the basics. This was a great investment of my time! Another semester, I received a small grant ($750) to hire a student to write the code to allow students to enter and edit their abstracts for the Chemistry 108 Poster Session directly on the web site.

The results

I used the Student Assessment of Learning Gains website to get feedback from students in the Spring, 2001 and received 63 responses (out of 110). The majority of students were very positive about the course and reported that:

- the topic-centered approach contributed significantly to their learning;
- the weekly quizzes (administered via the web) were very helpful to their learning;
- they understood chemistry and how to connect chemistry to their lives; and,
- they understood and would carry with them the issues surrounding ozone depletion, global warming, and air quality.

The students' comments emphasize their enjoyment of the topic-centered approach (and that the weekly quizzes require them to stay engaged with the material). A few from the end of the semester departmental evaluation appear below.

I like this course a lot. I didn't want to take chemistry, but I turned out to really like it. I'm glad I took 108 because I can now connect a lot of chemistry to my daily life.

I enjoyed this class mainly because I can use chemistry in everyday life. It helps me understand what goes around me.

It is neat how the content ties into the real world – not just boring chemical structures.

I value everything I learned in this course – it sparked my interest.

If you have any questions about our project, you can contact me at: chmiddle@facstaff.wisc.edu

LINKS
Chemistry 108 Spring, 2001: http://www.chem.wisc.edu/courses/108/108-Spring01/
Chemistry in Context: http://www.mhhe.com/physsci/chemistry/cic/
Chemistry in Context book description: http://www.acs.org/education/curriculum/context.html
Students speak out on Collaborative Learning: http://www.wcer.wisc.edu/cl1/cl/story/middlecc/TSCMA.htm
Student Assessment of Learning Gains: http://www.wcer.wisc.edu/salgains/instructor
ACS:

http://www.acs.org/
EPA: http://www.epa.gov/
NASA: http://www.nasa.gov/
NRC: http://www.nrc.gov/