Walking on the Web
Without Getting Stuck

by A. Malcolm Campbell

Introduction

After I read the article about Hyperteaching in the March/April issue, I wanted to share my experiences with the World Wide Web (WWW) and undergraduate teaching. I think Dr. Ahern made some very good points in his article that do not need to be repeated, so I will focus on specific examples of how I have woven the WWW into my courses. The guiding principle I have tried to maintain is to use the WWW only to augment my teaching goals, and not as bells and whistles to distract me. My aims have been:

1) I want students to be able to establish home pages and be familiar with HTML (the code that generates the WWW format) because I think all college graduates should develop this skill.
2) I want to provide information to students that I cannot photocopy or draw on the board.
) I want to archive certain research papers that I use in my courses, since the copies in the library are being destroyed due to repeated student use.
4) I want to establish an archive for research papers and posters that students have presented.
5) I want students to help me find good teaching sites on the Web.

Learning The WWW

In order to "encourage" students to learn how to make home pages, I give two assignments that must be posted on the Web. I utilize the computer center's ongoing tutorials in HTML to establish a foundation for students to use. The first assignment is for each student to establish a home page, describe one of the molecular methods we have covered in class, provide at least one image related to the molecular method he or she has chosen, and to establish at least one link to a related WWW site. They must also link their home pages to the home page for this course, and make it easy for people to email them from their home pages. All of this is graded very generously, so students will not feel punished for experimenting with their home pages. The real benefit s apparent when the second assignment is due, a term paper where students must choose a research paper to review, and propose additional experiments. They are not inhibited by the mechanics of producing material

for the WWW since they have done it once before. At the beginning of the semester, many students groaned about having to work with computers so much, but in the end, they became quite enthusiastic about their home pages and loaded many "extras" on their pages. To see a selection of these student home pages, visit *http:// www.davidson.edu/academic/biology/student/student.html* . It is important to remind students to cite the URL of origin for any images they use on their pages.

Dynamic Images

Biology is the study of dynamic processes, and many aspects of biology are difficult to draw on the board or photocopy. Therefore, it is useful to have images of complex structures available for teaching. These images can be used in classes that have a networked computer and a projector, or can be given to students as reading assignments. I have used images of cells labeled by immunofluorescence, karyotypes with fluorescence in situ hybridization (FISH), as well has diagrams I have drawn to clarify certain topics. Even more useful are files that allow me to view and manipulate molecules in 3D using the RasMol program (both the files and RasMol are free and can be access from the URL below). Finally, I have collected a variety of QuickTime (QT) movies which can be viewed with Netscape 3.0 or other comparable WWW browser. For example, it is difficult to draw a wave of calcium as it sweeps across an egg when fertilized, but one point and click initiates a 10 second QT movie that makes the calcium wave easy to understand. To facilitate student usage, I have collected the WWW sites of many images in a few convenient lists that can be accessed from this WWW site: *http://www.davidson.edu/ academic/biology/courses/courses.html* .

Cyber Reprints

For my upper level courses, I have increased my reliance on primary literature for teaching purposes, thus meeting several additional goals. It allows students to sink their teeth into a series of related papers where they must fully understand the data in order to extract the take home message. It enables students to get over their fears of reading scientific literature, and eventually they mature into critical readers. From these papers, students

are encouraged to design follow-up experiments (given unlimited budgets and unlimited time) they would like to perform to further the research topic at hand. All of these goals are reached when students struggle with good teaching papers. I am continuing my search for good teaching papers, but have found a few which can be accessed from *http://www.davidson.edu/academic/biology/courses/Bio304.html* . I had used these papers for a couple years, when I began to hear stories about the bound journals falling apart (I think that having the students find the articles in the stacks is another useful goal, but I have another mechanism for this and it does not send every student to the same paper).

Many of the figures in these papers have faint bands or immunofluorescence micrographs that are difficult to photocopy, so I did not want to make copies, to put on reserve, which the students would photocopy, again. Any subtle data would be lost in the version they finally read. So I got permission from the publishers to reproduce the papers on our WWW home page. Now the papers are permanently archived in good condition, students can print high quality copies for their reading, and I can use the computer in class to project each figure as we discuss them in class. I can show the figures on the white board and mark on the board as we work through the figures. This has had a significant impact on my teaching, and has been a huge success in class. (There is one caveat - I have had problems with Macintosh computers printing all the text from Netscape, while IBM PCs do not print the figures as well as Macintoshes do. Therefore, I have students print text from an IBM, and I use a Macintosh classroom for projecting the images during lecture. I hope these bugs will get worked out soon but they are minor inconveniences.)

Research Legacy

Like many other institutions, Davidson College encourages students to conduct research. In the past, the final papers would wind up on a faculty member's shelf and collect dust, or honors theses were sent to the library, where their fate was not significantly different. Now we use our WWW home page to present a showcase of student projects. As with many aspects of the WWW, we are inventing the rules as we go, but we have begun to post honors theses, poster presentations, and any term papers that faculty members want to have posted. This provides the department with several advantages. Prospective students can see (literally) the kinds of research our students conduct. Current students can explore research opportunities within the department when they are choosing mentors. Faculty can instruct students to read about past results as a starting place for current students conducting research. Alumni

can revisit their research presentations which can rekindle fond memories and strengthen ties with their *alma mater*. Even the dust covered theses can be cleaned off and added to the Web. With the aid of optical character recognition (OCR) programs, any text can be scanned and converted to electronic text with very little effort.

Black Hole of Time

I know what you're thinking. "Sure, I would do all this, too, if I only had the time." The great thing about the WWW is that students can do much of the work. Once you have given them a little assistance, they can generate most of the files to create the home pages. The latest generation of word processor programs and the advent of OCR has made the conversion of text to HTML only a click away, so teachers and students do not have to learn all the HTML tags. One or two work study students can assist a teacher by scanning images and converting the appropriate files to generate useful home pages. I have found that many students will spend hours looking at interesting WWW sites (some are even related to course work!) and they can help me locate additional sites that I might want to use in my courses. Once a critical mass of information is obtained on your WWW home page, there can be a significant level of cross-talk between classes and research, as well as between different courses. Showing students how the material learned in one class relates to other classes is another goal of many instructors, and can be facilitated by the WWW.

Conclusion

I am not a computer expert and do not know any programming languages, yet I have been able to build a useful WWW site for teaching. I have come to realize that making a good WWW home page is not a technical accomplishment as much as it is a creative one. Teachers are always using their imagination and creativity to impart knowledge. Using the WWW is just a slight variation on what we do every day. The challenge is to develop useful sites without losing too much time in the process. The big advantage we have is that we can learn from each other and borrow good ideas, so that we can establish a huge stockpile of teaching tools that is freely available to everyone.